THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXIX. No. 714.] LONDON, JANUARY 16, 1877. [29th Year.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—12,000 cubic feet of gas per ton of coal; 28-candle gas; coke, 68·70 per cent.; volatile matters, 33·30 per cent. Coke of good quality.

RAMSAY'S PATENT CONDENSED GARESFIELD COKE.

RAMSAY'S ORDINARY GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1828. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwentaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne.

Address G. H. Ramsay, Newcastle-on-Tyne.

GENUINE TORBAY PAINT
AND
SPECIAL GASOMETER PAINT.

Four Prize Medals. Established over 20 Years.

These Paints are now used in 150 Country Gas-Works, and by all the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.

They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.

The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov.* 2, 1866.

STEVENS & CO.,
(Successors to Samuel Calley.)
21, GT. WINCHESTER ST., LONDON.
Works: BRIXHAM, TORBAY.

THOMAS PROUD,
BROOKFIELD WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM,
MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS & PURIFIERS.
CONTRACTOR FOR
LAYING MAINS & ERECTING APPARATUS.
Light Steel Charging Coal and Coke Shovels, Charging Scoops, &c., &c., supplied promptly.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE.

Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas-Retorts and other Objects in Fire-Clay," and they were also awarded at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellence of Quality."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COALS.
Coal Office,
Quay Side, Newcastle-on-Tyne.

Jos. Cowen & Co. are the only Manufacturers of Fire-Bricks and Clay Retorts at Blaydon Burn.

JOHN RUSSELL AND CO.,
LIMITED,
THE WEDNESBURY TUBE-WORKS, WEDNESBURY;
AND
THE ALMA WORKS, WALSALL.
Established at the commencement of Gas Lighting.

Warehouses:
69, UPPER THAMES STREET;
COMMERCIAL STREET, SPITALFIELDS;
5, CHARLES STREET, SOHO; and
16, SOHO SQUARE, } LONDON.
35, 36, 37, & 39, GRANBY ROW, MANCHESTER.

J. R. & Co., Ld., are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.

J. R. & Co., Ld., make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanized Tubes and High-Pressure Tubes, &c.

Lists may be obtained on application to
69, UPPER THAMES STREET, LONDON.

JOHN BENT & SON,
BELL BARN ROAD, BIRMINGHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
OF
FIRST-CLASS MATERIALS & WORKMANSHIP;
Also, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.

Established 1830.

THOMAS PIGGOTT & CO.,
SPRING HILL, BIRMINGHAM.
MANUFACTURERS OF
TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.

Sugar, Saltpetre, and all kinds of Pans.
Roofs, Girders, and Bridges, and General Smith's Work.
London Agent—W. G. DAVIS, 2, Brabant Court, Philpot Lane, E.C.

J. & H. ROBUS,
BUILDERS AND CONTRACTORS
FOR THE
ERECTION AND REBUILDING OF GAS AND WATER WORKS.
ESTIMATES FREE
FOR MAIN-LAYING AND GENERAL REPAIRS.

RETORT-SETTING A SPÉCIALITÉ.

ROBUS'S IMPROVED RETORT-SETTINGS guaranteed to carbonize a large amount of coal with a small per cent. of fuel.

N.B.—All kinds of Fire Goods, &c., kept in stock for immediate delivery. Orders promptly attended to.

BELL GREEN, CATFORD, S.E.

THE
NITSHILL COMPANY'S
DUKE OF HAMILTON'S
LESMAHAGOW
CANNEL COAL.

AGENT:
JAMES M'KELVIE,
HAYMARKET,
EDINBURGH.

GEORGE GLOVER & CO.
PATENTEES OF THE
NATIONAL STANDARD GASOMETERS
FOR THE ENGLISH GOVERNMENT
AND FOR THE GOVERNMENT OF THE NETHERLANDS
AND OF THE DUPLICATE COPY
Presented by Her Majesty's Government to the French Government,
AND MANUFACTURERS OF
IMPROVED DRY GAS-METERS
Warranted to Measure correctly & not to vary.

RANELAGH WORKS, RANELAGH ROAD, PIMLICO, LONDON, S.W.
236, GEORGE STREET, GLASGOW, & 30, LANCASTER AVENUE, MANCHESTER.

FOREIGN AGENTS.
DAHL BROTHERS, COPENHAGEN. | W. HOVEN & SON, ROTTERDAM.
A. FAAS & Co. FRANKFORT O/M. | COPLAND & McLAREN, MONTREAL.
A. DEMPSTER, POST OFFICE PLACE, MELBOURNE.

JOSEPH AIRD,

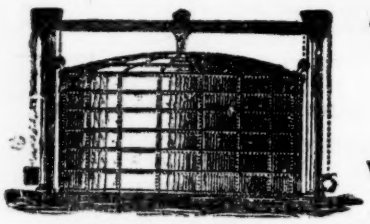
WELLINGTON TUBE-WORKS, TIPTON, STAFFORDSHIRE,

MANUFACTURER OF

EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
CORE BARS, COILS, COCKS (IRON OR BRASS),
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS



W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD

MANUFACTURERS OF

RETORTS, ANNULAR AND PIPE CONDENSERS,
WROUGHT AND CAST IRON SCRUBBERS, PURIFIERS,
GASHOLDERS,

GOVERNORS, AND ALL THE NECESSARY FITTINGS FOR COMPLETING THE ERECTION OF GAS-WORKS.

STATION & CONSUMERS WET OR DRY METERS, STREET & SERVICE MAINS, LAMP COLUMNS & BRACKETS, & WROUGHT-IRON TUBES AND FITTINGS; WROUGHT-IRON ROOFS FOR ANY SIZE OF BUILDINGS.

Sole Makers of B. W. Thurston's Combined Condensing, Scrubbing, and Washing Apparatus,
AND PATENTEES OF THE IMPROVED COMBINED CONDENSING AND PURIFYING APPARATUS SO EMINENTLY ADAPTED FOR EXPORTATION.

REFERENCES TO UPWARDS OF 300 GAS-WORKS.

LONDON OFFICES: 92, CANNON STREET.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

INCREASED VOLUME OF GAS PER TON.—INCREASED YIELD PER RETORT.—INCREASED BULK OF COKE FOR SALE.—REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.

A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to the Consulting Engineer, R. P. SPICE, Esq., M. Inst. C.E., 21, Parliament Street, London, S.W., or to the Engineer and Analyst, F. W. HARTLEY, Esq., A. Inst. C.E., 55, Millbank Street, London, S.W.

Established

1795.

JOSEPH CLIFF & SONS,

THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

London Wharf: No. 4, inside Great Northern Goods Station, King's Cross, N.;

LIVERPOOL: Back Leeds Street.

SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 800 days, and are yet in good order. References on application.

WHITEHOUSE AND COMPANY, LIMITED,

GLOBE TUBE-WORKS, WEDNESBURY; & VICTORIA TUBE-WORKS, GREAT BRIDGE, STAFFORDSHIRE,

MANUFACTURERS OF

PATENT WELDED WROUGHT-IRON TUBES,

FOR GAS, STEAM, AND WATER;

GAS-FITTERS TOOLS, STEAM COCKS, AND ALL KINDS OF JOINTS.

HYDRAULIC TUBES, CORE BARS, TELEGRAPH POSTS, COILS, &c.

London Agent—ALFRED LAKEMAN, 9, FENCHURCH STREET, E.C.

GAS PURIFICATION & CHEMICAL Co., LIMITED.

(Successors to JOHN WILLIAM O'NEILL & CO.,)

Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,

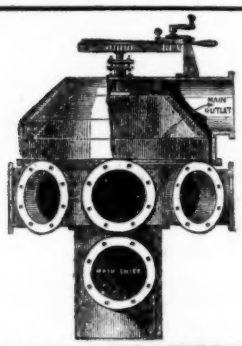
CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

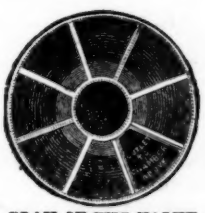
JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON, } Joint Managing Directors.

C. & W. WALKERS'

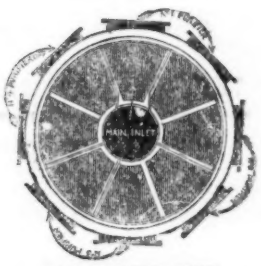
PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE.



PLAN OF THE VALVE.



PLAN OF THE BODY.

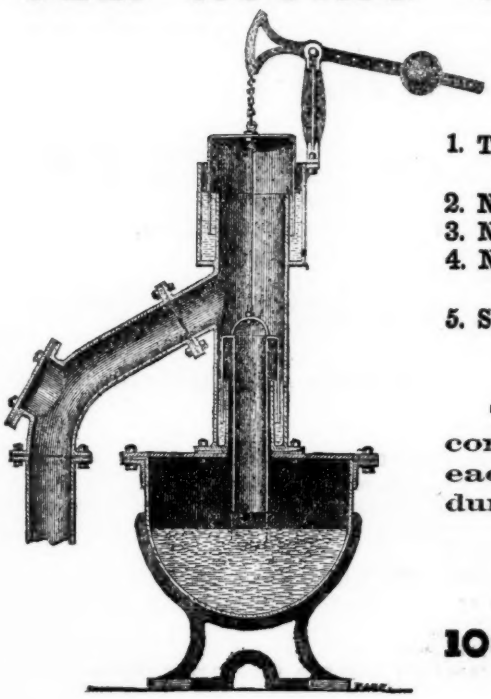
These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

SELF-ACTING REMOVABLE DIP-PIPE,

PATENTED BY

CHANDLER & STEVENSON.



ADVANTAGES.

1. There is no pressure on the Retorts.
2. No deposit of Carbon.
3. No scurfing is required.
4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
7. Is never out of order.
8. Requires no attention.
9. Is perfectly automatic in its action.

These Dip-Pipes can now be supplied complete, except the flanched bend, for £4 each, which includes the charge for licence during the whole term of the patent.

Applications to be made to

Messrs. CHANDLER & SONS,

104, NEWINGTON CAUSEWAY, S.E.,

Who fix the Dip-Pipes, at a small Charge, when required.

THE

IMPERIAL METER COMPANY,

LIMITED,

KING'S ROAD, LONDON, N.W.,

OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

Attention is called to their Dry Meters in Wood Cases, as used by the principal London Gas Companies. These Meters are especially suitable for seaport towns and for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

EDWARD E. CROMBIE & CO.,

INVENTORS AND PATENTEES

OF THE

FRICTIONLESS DRY GAS-METERS,

Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

METROPOLITAN WORKS, DIANA PLACE, EUSTON ROAD, LONDON, N.W.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS.

And all kinds of Experimental Gas Apparatus.

WILLEY & COMPANY,

GAS ENGINEERS,

WORKS: COMMERCIAL ROAD, EXETER,

INVITE THE ATTENTION OF GAS COMPANIES AND OTHERS FOR THE SUPPLY OF

EVERY DESCRIPTION OF GAS APPARATUS.

ENGINEERING DEPARTMENT.

NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.

GASHOLDERS AND TANKS.

RETORTS and RETORT-HOUSE FITTINGS, CONDENSERS, SCRUBBERS, ENGINES and EXHAUSTERS, PURIFIERS, STATION-METERS, GOVERNORS, VALVES, &c.

METER DEPARTMENT.

They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.

GAS-FITTING DEPARTMENT.

An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.

PATTERN-BOOKS and PRICE LISTS furnished.

☞ PLEASE NOTE THE ADDRESS—

GAS ENGINEERING WORKS, COMMERCIAL ROAD, EXETER.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD,

MANUFACTURERS OF

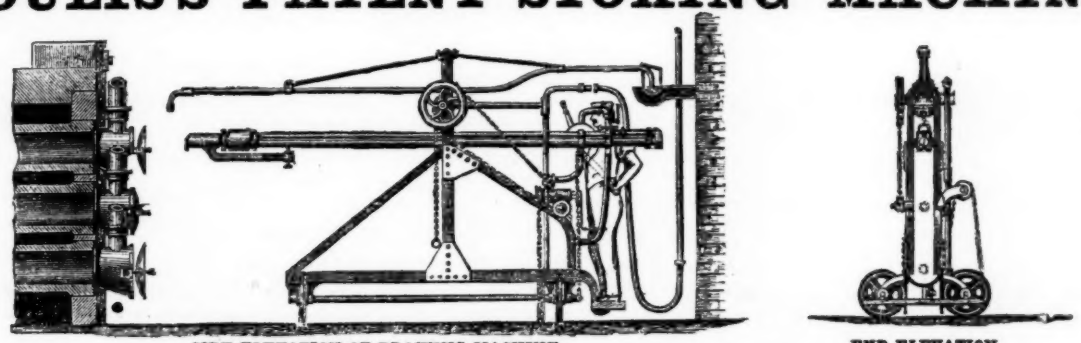
IMPROVED CENTRE-VALVES,

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF DRAWING MACHINE. END ELEVATION.

(The Charging Machine will be Illustrated in next week's Advertisement.)

Makers: **TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester; ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz:**
Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

THOMAS ALLAN & SONS,

IRONFOUNDERS,

WORKS:

SPRINGBANK FOUNDRY & NORTH WOODSIDE FOUNDRY,

GLASGOW;

BONLEA FOUNDRY, STOCKTON-ON-TEES,

Manufacturers of

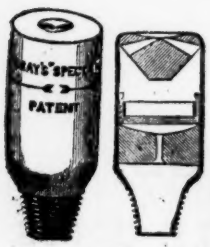
CAST-IRON GAS AND WATER PIPES.

SIZES: ¾ to 12 inches at GLASGOW.
„ 1½ to 7 „ STOCKTON.

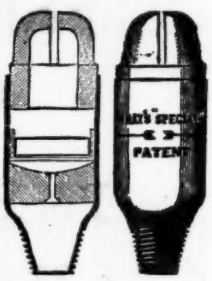
A LARGE STOCK KEPT, AND PRICES MODERATE.

Freight to London, in the Stream, 10s. per ton from Stockton; 12s. 6d. from Glasgow.

London Agent: Mr. A. C. FRASER, ST. STEPHEN'S CHAMBERS, TELEGRAPH STREET.



BRAY'S NEW GAS-BURNERS.



BRAY'S "SPECIAL"
TRADE ◄——● ●——► MARK.
PATENT.

A NEW FEATURE IN GAS LIGHTING.

OUR WELL-KNOWN

PATENT "ENAMEL" REGULATOR GAS-BURNERS

(UNION JETS AND BAT'S-WINGS)

Were designed as improvements on the common Burners, and that object has been so successfully attained that they have, we believe, met with more approval and recommendation from the Gas Engineering Profession and the Public than have been accorded to any other firm's make of Burners since the commencement of gas lighting.

Of the two kinds of Burners—the Union Jet and Bat's-wing—in general use, the latter is the least useful, because of its want of adaptability to general circumstances, and great liability to get out of order; but, when in good order, it has hitherto had the advantage of yielding more light with common and medium qualities of gas than the Union Jet. The Union Jet, on the other hand, has the advantage of greater adaptability, being useful everywhere, is less liable to get out of order, requires scarcely any attention, and will stand more rough usage. Notwithstanding these great practical advantages, which are almost everything in a Gas-Burner, Gas-Burner improvers have been attracted to the Bat's-wing, because of its giving a more showy result when tested for illuminating power only.

We have succeeded in improving both Bat's-wing and Union Jet Burners; but, while adding materially to the efficiency of the first-named, it is specially noteworthy that the Union Jet has received most advancement by these improvements. While retaining all the advantages of the Union Jet, we have brought it up in ILLUMINATING POWER to the level of the most expensive Bat's-wings specially got up for developing that feature. The result is such that we have no hesitation in pronouncing BRAY'S "SPECIAL" UNION JET

THE BEST BURNER HITHERTO PRODUCED,

AND

A NEW FEATURE IN GAS LIGHTING.

The leading features of this NEW UNION JET may be summarized as follows:—

It gives more light, from the smallest to the largest sizes, than any Union Jet was ever before known to give.

It gives 30 to 60 per cent. more light than the common Union Jets, and 15 to 20 per cent. more than our own much commended Patent "Enamel" Union Jet.

It gives as much light as the most expensive Bat's-wings specially constructed for high illuminating power, without the Bat's-wing's disadvantages.

Tested on the Photometer at various consumptions—say, 3, 4, and 5 feet of Gas per Hour, or any similar variation—and the results averaged, our New Burner will show a higher illuminating power than the best Argand. If the tests are made downwards and upwards as well as laterally, the results will be still more in favour of our New Burner.

ADDITIONAL ADVANTAGES possessed by our NEW BURNER over all others in the market, and these are applicable and are added to our IMPROVED BAT'S-WING:—

In all Burners having an arrangement for diminishing the flow of Gas before it arrives at the point of ignition, that part of the Burner which effects this object has been a source of weakness, because of its being placed in a position very liable to fracture, and easily tampered with. Indeed, this is so arranged that any one can get at and break or widen out the inlet for the Gas at pleasure, and make what ought to be an economical Burner a most extravagant one. In our New Burner, this part is so hard that it cannot be enlarged by drilling, and is so arranged that it cannot be otherwise tampered with without breaking up the whole Burner; this forming, we believe, the most efficient safeguard yet introduced against the extravagant use of Gas by those who have not to pay for it.

The Gas Supply being given through one ROUND hole, which is made through non-corrosive material, it is not so liable to stop up or get out of order as in cases where a number of small holes or narrow slits are used. When these holes are made through *metal*, the lasting property of the Burner so constructed is almost *nil*, even if the aperture is not tampered with.

There is no hissing noise caused by the passage of Gas through the diminishing arrangement of this Burner.

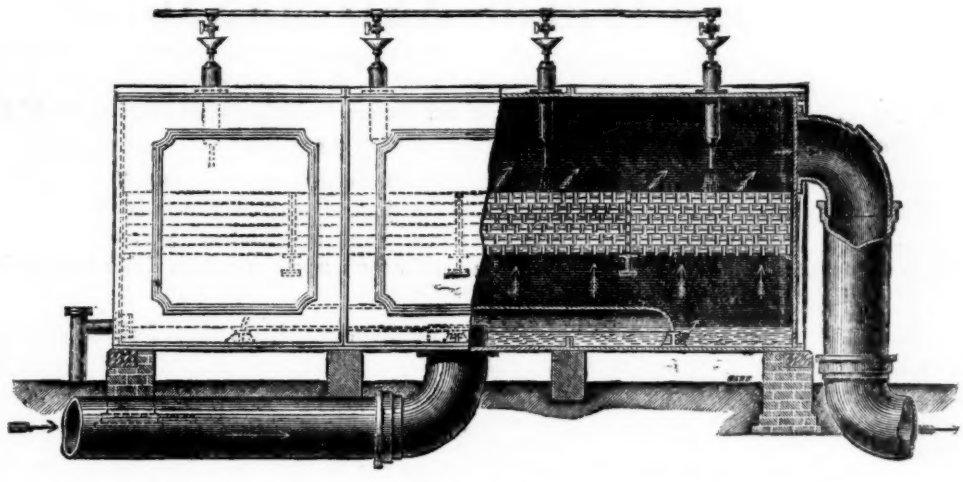
☞ All our "Special" Burners have our Trade Mark stamped on the sockets thus BRAY'S "SPECIAL" ◄——● ●——► PATENT.

GEORGE BRAY & CO., BLACKMAN LANE, LEEDS.

GAS PURIFICATION.

SAVILLE'S

SELF-DISTRIBUTING GAS SCRUBBER-WASHER.



MECHANICAL ARRANGEMENT.

THE Washer Tank contains a large bottom chamber, into which the Gas is freely admitted through an ordinary full-way inlet-pipe, passing first under an inverted vessel which removes any Tar remaining in the Gas after leaving the Condenser; it then rises slowly over the whole surface, CONTAINING AN AREA OF ABOUT EIGHT TIMES THAT OF THE INLET-PIPE, through equidistant spaces in a series of Self-Sealing Water Troughs, arranged in tiers, dividing itself and passing through the various dips until it reaches the upper chamber, and from thence through the outlet-main.

The washing liquid being CLEAN WATER is admitted by the Syphon inlets on top of Tank to the upper row of troughs, running through each successive tier, and becoming impregnated with the impurities extracted from the Gas, gaining strength at each dip on its descent, and finally passing off by the outlet syphon at the bottom.

It will be observed that in this Scrubber-Washer the Gas comes first in contact with THE STRONGEST LIQUOR at the bottom, and passes through WEAKER LIQUOR at each successive tier, until it issues through CLEAN WATER into the upper chamber; hence the true principle of Gas Purification by Washing is simply and automatically effected.

ADVANTAGES.

Great economy in first cost and foundations.
Great saving of other purifying apparatus and material.
Occupies little space, and stands only a few feet in height.
Being entirely self-acting, requires no motive power either for purifying or distributing.
The Gas is washed several times in ONE vessel, each time in liquor of a different strength, ultimately passing through CLEAN WATER.
Produces liquor of any required strength by once passing through.
Can be fixed (if desired) at any elevation to permit Contractors' tanks being filled without the expense of pumping.

One of these Scrubber-Washers has been in successful operation for the past twelve months at the Sowerby Bridge Gas-Works, and they are now being erected at the Corporation Gas-Works, Windsor Street, Birmingham, and at the Phœnix Gas-Works, Vauxhall, London.

Prices and full Particulars on application to

TANGYE BROTHERS AND HOLMAN,

Sole Manufacturers,

LAURENCE POUNTNEY LANE, LONDON, E.C.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

TO GAS ENGINEERS AND MANAGERS.

It having come to our knowledge that a report is in circulation, spread by some unprincipled person or persons, that the cases of our larger-sized Meters are made of Galvanized Iron, we think it only fair to ourselves, and just to our customers, to say, that we never have used, in making any of our Meters, a single pound of *Galvanized Iron*, or any other *cheap* and *inferior material*, and this can be easily seen by opening any of them.

The cases of our large-sized Meters, from 20 lights and upwards, are all made of the very *Best Best Patent Alloy*, which is nearly double the price, and will last more than double the time, of some other material that has been and still is very largely used for the same purpose. And our experience, acquired by an extensive use of it for upwards of 30 years, enables us to say with confidence that no other metal in use for the purpose is so little liable to corrosion from the action of the gas.

We have now in use a Meter made in 1848, and therefore 29 years old, the case of which is made of Patent Alloy; the Meter is still in perfect order, and shows no signs of decay.

The utmost care is exercised by us in selecting none but the very best materials for all parts of our Meters; much of it is made *expressly for us*, as it is not possible to obtain it in the open market of the same superior quality.

The great fall in the price of all materials used in making our Meters has enabled us to give an increased discount, thus giving our customers the benefit of the fall. This we were bound in fairness to do, as we raised the price of our Meters four years ago, when the price of all metals went up.

It will be our constant endeavour, by using none but the best materials, and employing the most skilful workmen, to maintain the high character our Meter has hitherto borne.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

MANUFACTURERS OF PATENT

WET & DRY GAS-METERS,

STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

AND EXPERIMENTAL APPARATUS,

STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

METERS FOR MEASURING WATER.

CONTENTS.

Circular to Gas Companies:— PAGE
Gas Companies and Commissions . . . 81
Gas Affairs at Leeds . . . 82
Gas Accounts of the Corporation of Bolton . . . 82
Gas Affairs at Lowestoft . . . 82
Proposed Purchase of the Warrington Gas-Works . . . 82
The Threatened Purchase of the Ramsgate Gas Company . . . 82
Water and Sanitary Notes:—
The Thames Inundations and their Prevention . . . 82
Necessity for a London Municipality . . . 82
Disposal of the Sewage of Colchester . . . 82
Leading Article:—
A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas . . . 83
Communicated Article:—
French Practice in the Construction of Gasholders. By Dr. William Pole, F.R.S., M. Inst. C.E., &c. . . . 84
Correspondence:—
Price of Gas at Preston . . . 86
Buenos Ayres Gas Supply . . . 86
Goats on Ass-Making . . . 86
Parliamentary Intelligence:—
Gas and Water Bills, 1877 . . . 86
Legal Intelligence:
High Court of Justice—Chancery Division—The Corporation of Blackburn *v.* The Guardians of Blackburn . . . 86
Warwickshire Quarter Sessions—Corporation of Birmingham, *Appellants*, *v.* The Parish of Shustoke, *Respondents* . . . 86
Miscellaneous News:—
Reduction in the Price of Gas . . . 85
Testimonial to Mr. James Watson . . . 85
Llandaff Water Supply . . . 85
Barbadoes Gas Company . . . 85
Barton Local Board District Gas Supply . . . 86
Metropolis Water Supply . . . 91
Richmond Water Supply . . . 91
Bolton Corporation Gas-Works . . . 91
Meeting of the Bilston Gas Company . . . 92
Carlisle Corporation Gas and Water Works . . . 93
Proposed Purchase of the Warrington Gas-Works . . . 93
Leeds Corporation Gas Supply . . . 93
Fatal Gas Explosion at Pimlico . . . 93
On the Best and Most Economic Method of Laying Mains Gas-Tight, and of Discovering and Remedying Leakages. By M. Monnier . . . 94
Commissions . . . 95
Improvements in Street Lighting . . . 96
Birmingham Water Supply . . . 96
New Gas Company . . . 96
Trade Reports . . . 96
Sale of Gas Shares at Cardiff . . . 97
Waste of Water in Dublin . . . 97
Glasgow Water Supply . . . 97
Bradford Gas and Water-Works . . . 97
Accident at the Rotherham New Gas-Works . . . 97
The Paraffin Oil Trade . . . 97
Coal Gas and its Application to House Lighting . . . 97
Register of New Patents:—
Barrett and Hargreaves—Apparatus for Regulating, Controlling, and Directing the Flow of Liquids . . . 98
Dubois, J. L.—Cocks or Taps . . . 98
Adair, W.—Pumps . . . 98
Applications for Letters Patent . . . 98
Patents which have passed the Great Seal . . . 98

NOTICE TO SUBSCRIBERS.

The JOURNAL OF GAS LIGHTING is supplied direct from the Office to residents in any part of the United Kingdom, at the rate of 21s. per annum, payable in advance. If credit be taken, the charge is 25s.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the year 1877, are reminded that this can only be done during January.

Vol. XXVIII. (second half of 1876) will shortly be ready, bound in cloth, gilt letters, price 16s. Cloth cases for binding may now be obtained on order from any bookseller, or from the Publisher.

TO CORRESPONDENTS.

W. C. B.—1. *Oval retorts, clay, 21 inches by 14 inches, or 21 inches by 15 inches, and 9 feet long, properly heated, will produce, on an average, 5200 cubic feet per diem, with Newcastle coal.* 2. *Six-hour charges, 2¼ cwt. each.* 3. *Enlarge the scoop, or charge with shovel.*

C. H. F.—*Your inquiry respecting the proportionate rateability of stone quarries and iron ore works to other property in the assessment of a lighting rate, is hardly within our province to furnish a reply to.*

D. H.—*If our correspondent's question be, whether gas will improve in illuminating power after being made for 24 hours, our answer is, that it will not. Whether it will deteriorate or not depends upon circumstances.*

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 16, 1877.

Circular to Gas Companies.

SOME months ago there was a good deal of correspondence in a Glasgow paper on the subject of the payment of commissions by coal dealers to managers and other officials connected with gas undertakings. We took but little notice of it, although several letters on the matter were addressed to us, for a perusal of the correspondence seemed to prove to us that it had its origin in a purely personal grievance. The general question of the morality of taking commissions has, however, been recently raised in the columns of *The Times*, and when Bedford Row and Capel Court are boldly attacked, the small fry of gas officials could hardly hope to escape.

Accordingly, we find a letter published in *The Times*, which we have thought right to transfer to our columns, in order that it may have a wider circulation among gas officials than it could otherwise possibly obtain. It is well for men to know the worst that can be said of them.

On the general question we shall say very little. The commission pestilence is an outcome of the present age, in which every man seeks to obtain the most money possible for the least amount of work, and, until now, only the artizan has been blamed. This latter has no chance of obtaining a commission, so he does his work in his own way; but ascending in the social scale, we find the disease permeating every class of society. Why, then, should the poor gas manager be expected to be exempt? We may at once admit that the taking of commissions is very general among them, though by no means universal; and what is the reason? It is simply because (in our special case) people who have goods to sell, offer bribes to those who have the power to recommend their purchase. The "Commission Abolitionist," whose letter we print, freely admits, that probably, if he had never bribed, his business would never have grown to its present profitable dimensions. He was not content to rely on the excellence of his wares alone. He has got on in the world by a sort of "purchase system," and now he is disposed to kick down the ladder, by the use of which he arrived at fortune.

It must not for a moment be considered that we defend the practice of paying and receiving commissions. We regard it as utterly vicious; but let the blame be fairly divided. In the first place, it is well known that Gas Companies and Corporations (we do not include all) pay their officials inadequate salaries, on the distinct understanding that they will receive gratuities and commissions. If this were not the case, perhaps some clever Directors or pushing Aldermen and Town Councillors would contrive to absorb the *douceur*. It is not only managers who are canvassed for business, and it is not they alone who must be accused of taking bribes.

The defence of the practice of accepting commissions lies, as is stated by the writer whose letter we print, in the assertion that the amount paid is only so much taken out of the seller's profits. As a question in political economy the statement requires no answer. It is that much be-wronged individual, the gas consumer, who pays everything. True, when a company do not pay maximum dividends, the commission may be supposed to be a deduction from profit applicable to dividend, and thus the shareholders may be considered as robbed. But who knows whether a seller, certain of a market, would part with his goods at a lower price, even if he did not pay a commission? If we dared to adduce instances, we think we might show that, in many cases, the non-payment would only result in the commission-money going into the pocket of the seller. The maxims of political economy do not apply in all cases.

There is one passage in the letter to *The Times* which deserves some particular remarks. The writer alleges that it is the custom of managers leaving a situation to overstock the concern they are quitting. If this be done—and the writer says he knows for a fact that it is—the Directors of the Company are little less to blame than the outgoing Manager; and we draw especial attention to the point, for their edification. Effective superintendence would at once put a stop to practices of this kind, which, after all, we must believe cannot be common.

We need not say anything in defence of consulting engineers. They are quite capable of taking care of themselves. The mode in which they are paid may not be the best that could be devised, but it has been settled by custom. They get their commission, like architects, on the cost of the works they design and see carried out; but we do not believe that any respectable consulting engineer ever takes a commission from a contractor.

We have nothing to say against the correspondent of *The Times*, except that he evidently lacks moral courage. He admits as much. He falls in with a system of which he disapproves, because he finds it to his advantage to do so. He fears, or knows, that his business would leave him if he did not bribe; so he bribes and grumbles. We do not believe in this sort of virtue. Let our first-class firms resolutely set their faces against the practice, and it would quickly come to an end. If the writer would boldly avow himself, and try it, we should heartily wish him success. Competition in excellence would be substituted for competition in bribing, and the moral atmosphere of many gas undertakings would be vastly improved. As we said when commenting, some time ago, on the Glasgow revelations, the bribers are as much to blame as the bribed.

A word to directors and local authorities. It is, we fear, notorious that, as said above, a number of managers are paid small and inadequate salaries because it is understood that they will receive commissions on everything that goes into the works.

This state of things should be remedied at once. A manager should receive a fair initial salary for the labour he must devote to the necessary work of superintendence. Beyond this, there might be inaugurated a system of "payment for results." Should the engineer reduce the "leakage," bring down the fuel account, and increase the production of gas, or do aught, in fact, to increase the efficiency of the undertaking, he should receive a proportionate reward. In such an event, directors and authorities might bind their officials not to receive commissions, either in money or gifts. We shall, no doubt, hear a good deal more of this question, now that it is once again ventilated, and need say no more at present.

We have, more than once, referred to the complaints made against the Corporation gas supply at Leeds, and it is with no pleasure that we recur to them. But it appears, from the report of a recent meeting of the Chamber of Commerce, that they are becoming louder and stronger. Leading consumers, it will be seen in another column, lament the departed days of the two companies. They had their shortcomings, but, we believe, it must be admitted that the quality of their gas was well maintained, if, in the case of one, the pressure was sometimes insufficient. We may say at once that, without the evidence of a competent examiner, which is not before us, we must decline to accept the statement in the report of the Council of the Chamber of Commerce as a rigidly truthful expression of fact. We are so used to exaggerations, that we no more believe an accusation brought against a Corporation than we do one made against a Gas Company. That there are, however, some grounds for the complaints made at Leeds we must believe. The Corporation, at the outset, did not, perhaps, make a very good bargain, and they have been far from displaying the enterprise which was necessary to place the whole undertaking in a satisfactory condition. They have, to use the expression we employed last week, rather "starved" the concern. Judging by the Bill they are promoting in the next session, they are about to repair the error, and due consideration should be shown by the Chamber of Commerce. If the Leeds gas undertaking be not put into first-class form in the course of the next two years, the Town Council may be justly blamed. We do not say that they may not be found fault with to-day, but, in extenuation of their conduct, we may state that the Corporation have only exhibited a weakness common to local authorities.

The Gas Accounts of the Corporation of Bolton reveal a satisfactory condition of affairs. The profits made in the past year amount to £11,336, as against £6272 in the previous year. Out of the sum mentioned, £3000 has been appropriated in "aid of rates," the rest being devoted to the payment of necessary charges. With a sustained prosperity, which is guaranteed for the current year, the Town Council will, we feel certain, be able to make some reduction in the price of gas in the course of another half year.

A Medical Officer of Health at Lowestoft recently reported that the gas supplied to the town was of very inferior quality, and concluded his remarks by suggesting that the Improvement Commissioners should provide the means for testing it. How, in the absence of such apparatus, he arrived at the conclusion that the gas was bad, he did not explain. Probably, he guessed. While the complaint was being made, it was remarked that the gas burning in the board-room was "very brilliant indeed." It seems, however, to be admitted, that for some weeks there may have been grounds of complaint, for the works have been undergoing alterations, and the weather, we presume, has delayed their completion. Whatever they may be, we have no doubt that all cause of complaint will soon be removed by the able Engineer of the works.

Local newspapers are always amusing reading when gas is the topic under discussion. We have referred to the Warrington journals, which have yielded fun, and never more than in the most recent reports published in them, which show that the disputants have resorted to pugilistic arguments. With regard to this case, we may mention that a proposal has been made that Mr. T. Hawksley should be called in, to give a decisive opinion as to the reasonableness of the price agreed upon. No higher authority can possibly be consulted; and the opinion, which we hope will be obtained, should be accepted with respect by both parties.

The correspondence in the Ramsgate press, though grave and decorous, is scarcely less amusing than the account of the proceedings at Warrington, because of the hallucinations of the writers, and the ignorance displayed by them of the manner in which Parliament usually deals with cases such as will be presented, during the next session, in the Ramsgate Gas and Water Bills. Whatever may be the result of the contest, it is clear that many of the Ramsgate public are indulging hopes, and entertaining fears, which will never be realized. The sum the Local Board will have to pay, if they succeed in obtaining power to acquire the undertakings, is scarcely doubtful, and it will soon be discovered that this amount will effectually prevent any reduction of price until the business, by a natural development, is greatly extended. It has rarely happened that a purchased gas undertaking has become immediately profitable to the purchasing authority; but it has happened, in not a few cases, that the works have for years been carried on with the narrowest margin of profit, and in some an actual loss has been sustained for a period. We do not remember a single instance in which a reduction of price followed on the acquisition of the undertaking. Hence, we anticipate that that section of the Ramsgate public, who expect a large reduction in the rates, and equal benefits in the shape of a reduction in the price of gas, are certain to be disappointed. The two things are, in fact, incompatible. A middle-aged inhabitant, if of sound constitution, may, perhaps, live to pay for cheaper gas, with unreduced, but much more probably increased, rates; but cheap gas and low rates he will never survive to witness. Coal will never cost much less than it does to-day, and if it should be much cheaper it would bode no good to Ramsgate, which is mainly dependent for such prosperity as it enjoys on the expenditure of what we may call surplus profits.

Water and Sanitary Notes.

The all-absorbing local question in the Metropolis, to-day, is the prevention of inundations, respecting which a good deal of controversy rages, not so much as to the means to be adopted, but as to who shall pay for the work. A majority of the Metropolitan Board of Works are disposed to compel the riparian authorities to construct the embankments necessary for their protection. Now, it is true that a parish is a unit, but it is sometimes made up of parts, the inhabitants of which have few interests in common. Thus the well-to-do dwellers in the upper parts of Lambeth, who never suffer from floods, fail to see why they should be rated for the benefit of those who herd close to the river banks, and get occasionally washed out of house and home. In their opinion they are no more interested in the matter—that is, only interested to the same extent as—the ratepayers of Highgate and Hampstead, who are perfectly safe from overflows of the Thames. They, therefore, urge that the cost of the works should be defrayed by a general metropolitan rate, and there is a good deal to be said, both for and against the proposition. We are disposed, not without misgivings, to agree with those who contend for the metropolitan character of the work. The source of our doubts need not be mentioned. This, however, we may say—that if London had, at the present moment, a proper Municipal constitution, the question would never have arisen. In Manchester, Liverpool, or Glasgow—all made up of several parishes, welded, for certain purposes, into a homogeneous Municipality—no difficulty would have been experienced. Mr. Beal will take notice of the present dispute. Lord Camperdown will see, more clearly than ever, that the members of the Metropolitan Board of Works are mere delegates of Vestries, representing local jealousies rather than the general metropolitan interest. It is too much to expect any immediate change, but these disastrous floods will not have been without their advantage, if they call special attention to the necessity for an efficient Municipal Government for London.

Colchester has been in difficulties about the disposal of its sewage for some years. It was at one time, we rather think, contemplated to carry a main sewer for some miles along the bank of the river Colne, and then discharge the sewage into the estuary. A sewage farm was also thought of; but both these schemes appear to have been given up. Now, however, a Sub-Committee of the Town Council have been visiting places where precipitation processes are carried on, and appear to have been struck with the merits of Hillé's system, which is practised at Edmonton, Tottenham, Wimbledon, and Taunton. The inventor of this system offers no promise of profits to local authorities. His efforts are directed to the treatment of the sewage at the lowest possible cost, provided a decent effluent water be obtained. No pretence is made of producing marketable manure; but the sludge is disposed of by pumping it on to a small area of land, where, in fact, a system of intermittent downward filtration is carried out. If any difficulty be found in working this system, it will be caused by an accumulation of sludge; but this may be provided against for many years, by taking sufficient land. The process was described in our columns a year or two ago, and we need only say here, that the precipitant is a mixture of chloride of magnesium and lime, with a little crude carbolic acid as a disinfector.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CXXV.

Main-Pipes (*continued*).

At the close of our last chapter we referred to the method of jointing with Russian tallow. The metal of the socket in this case need not be stronger than that in the body of the pipe. Several coils of spun-yarn, covered with putty or very thick paint, are first driven into the bottom of the socket. Tarred gasket, made of such a thickness as to fit tightly into the annular space between the spigot and the socket, is then caulked round the lip of the latter in such a manner as to leave about 1½ inch of space between the yarns. On the upper side of the pipe the ends of the gasket are drawn out to form a mouth, and a mixture of two parts of melted Russian tallow and one part of common vegetable oil being poured, while warm, through the mouth, runs into, and fills up the space all round. Fig. 19 shows the complete joint; the light portions of the plugging being the yarns, and the dark portion between them the tallow.

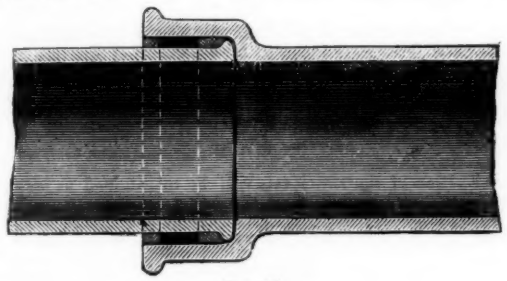


Fig. 19.

In the earlier days of gas lighting, after the objections to the use of the rigid flange joint had become apparent, the lead joint, as described in our last week's article, was invariably employed in the laying of mains. Even at the present day, some managers prefer this before any other. Whilst admitting, and that not unreservedly, its excellence when carefully made, and its value and utility under certain extreme conditions, such as the subsidence of the ground in which the mains are laid, we believe that, in a general way, it cannot be compared with the bored and turned joint, either on the score of cheapness, tightness, or durability. It is much to the credit of the late Mr. Alfred King, the able engineer of the Liverpool Gas-Works, that he was the first to apply this latter description of joint, having adopted it as far back as the year 1826. These are universally in use in the streets of Liverpool and Manchester, where the traffic is enormous, and where defective and insufficient joints would be particularly objectionable.

It is sometimes urged, in opposition to the turned and bored joints, probably by those who have had least experience in their use, that, owing to the contraction of the metal in winter, the pipes are drawn, and that heavy leakage is the consequence. If there is any foundation of truth in this allegation, it arises from defects that need not necessarily present themselves.

The failure of some of these in places where they were adopted for the first time, was due to the circumstance of the surfaces having been made too tapering in form. It is well known that the more conical a plug is made, the easier it is of displacement from its seat, and the wider the interval between its surface and that of its seating produced by an equal extent of withdrawal. So in the matter of which we are treating, the nearer the two surfaces can be kept to the true cylindrical shape, the better, not only for ease in connecting, but in permanent efficiency and tightness. We know, as a matter of fact, that leakage rarely occurs with properly constructed —that is, all but cylindrical—joints, such as we have described.

It must be remembered that there is a lateral as well as a longitudinal contraction of the metal; and as the socket of the pipe has a greater bulk of metal than the spigot, it follows, as a natural consequence, that it contracts to a greater extent than the other, so retaining the soundness of the joint, notwithstanding the drawing of the pipe end from its original seat.

As a general rule, then, it may be asserted that pipes with bored and turned socket and spigot joints are superior to all others for gas-mains. Their first cost is not more, or but a trifle more, than open joints. The speed, certainty, and cheapness with which they can be made, far exceed most others in these respects. The soundness and durability of the joint is undoubted, and the ease with which it can be taken asunder, without damaging the pipes, in cases of renewal and enlargement of mains, is not its least recommendation. The bored and turned joint is easily manipulated so as readily to follow any ordinary curves, but when these are sharp and angular, an occasional lead or iron cement joint has to be employed.

The application of the turned and bored principle to the joints of the various branches and bends required in main-laying is more difficult, and, consequently, not so common as with the straight lengths, although it has been attempted in several instances with success.

In laying turned and bored pipes, the spigot and socket ends are carefully cleaned with cotton waste; and if rusty in any degree, by a piece of wire card. It is scarcely needful to say that the use of a file for that purpose is altogether inadmissible. The clean surfaces are then covered, by means of a brush, with a coating of thick paint, composed of one part of white and one part of red lead, mixed with boiled linseed oil. The pipe is then lowered into the trench, the end inserted and driven home with a mallet if the pipes are of small diameter, or with a swing tupping-block if large.

In driving the pipes, they will sometimes be found to spring back at every stroke. This may be due to one of two causes—either the joint is too conical in form, as previously mentioned, or there is a slight ridge or roughness left on the inside edge of the bored part of the socket, or turned portion of the spigot. This latter can easily be removed with a chisel; but the former is a radical defect that is incurable—a permanently close and durable joint under the circumstances being impossible.

One great merit of the turned and bored joint is the ease and facility, and the consequent saving in cost, with which pipes can be joined by its aid. This economy would, of course, go for nothing, if the after results of the system were unsatisfactory; but when it is found that the economy is supplemented by efficiency, then we realize the full value of the work.

We have no hesitation in speaking strongly on this point, having had a long and varied experience with the different joints, under the most opposite conditions of soil, situation, and temperature, in recommending the general adoption by managers and engineers of the bored and turned joint in the laying of ordinary gas-mains, resorting to the use of lead, or of iron cement, in the jointing of the various branch-pipes and bends.

In a paper read before the British Association of Gas Managers in 1868, by the late Mr. Rafferty, of Manchester, whose experience on all matters connected with main and service laying was very great, the following estimate of the saving effected per joint, in laying a 30-inch diameter turned and bored, as compared with a lead-jointed main, is given. The particulars of the items dispensed with, and which are required in making a lead joint of the size named, are as follows:—

	£	s.	d.
54 lbs. of lead, at 2·4d.	0	10	9½
White yarn, 4½ lbs., at 8d.	0	3	0
Making caulking chamber	0	1	9
Melting lead and making joint	0	0	10
Quarter cwt. of coal	0	0	2
Extra soil to be carted away	0	1	1½
Flagging or pavement taken up and relaid, 3 yards, at 1s. per yard	0	3	0
	£1	0	8

Since the year mentioned, the cost of both labour and material has increased, consequently the gross saving of the turned and bored over the lead jointing will be greater at the present time than is represented by the above sum. An allowance ought to be made in the calculation for the cost of the red and white lead paint used for coating the turned and bored joint of the size given. A sum of 4d. will be ample for this purpose.

We append a useful table giving the approved thickness of metal in the sockets, and also in the body, of turned and bored pipes of the different sizes, from 2 inches up to 20 inches, the accompanying engraving (fig. 20) explaining the particular parts to which reference is made. The depth of the socket is also stated in each instance.

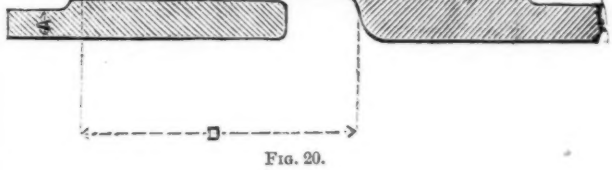


Fig. 20.

TABLE

Of the Thickness of the Metal and the Depth of the Sockets (inside Measure) of Turned and Bored Cast-Iron Gas-Pipes.

Dia. of Pipe.	A	B	C	D	Dia. of Pipe.	A	B	C	D
Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
2	5-16ths	7/8	1/4	3	10	5-10ths full	1⅛	¼	4½
2½	3-8ths bare	1⅛	5/16	3½	11	9-16ths	1⅛	5/16	4½
3	3-8ths	1	5/16	3½	12	9-16ths	1⅛	5/16	4½
3½	3-8ths	1⅛	5/16	3½	13	9-16ths full	1⅛	5/16	4½
4	3-8ths full	1⅛	5/16	4	14	9-16ths full	1⅛	5/16	4½
5	3-8ths full	1⅛	5/16	4	15	9-16ths full	2	1	5
6	5-10ths	1⅛	3/8	4½	16	5-8ths	2	1	5
7	5-10ths	1⅛	3/8	4½	17	5-8ths	2⅛	1 1/16	5¼
8	5-10ths	1⅛	7/16	4½	18	11-16ths	2⅛	1 1/16	5¼
9	5-10ths	1⅛	7/16	4½	20	11-16ths	2¼	1⅛	5¼

It is sometimes preferred by engineers to combine the turned and bored with the lead or cement joint, by having the socket of the pipe cast with a recess in front of the bored part of about 1½ or 2 inches in depth (fig. 21), so that in the event of leakage from the turned and

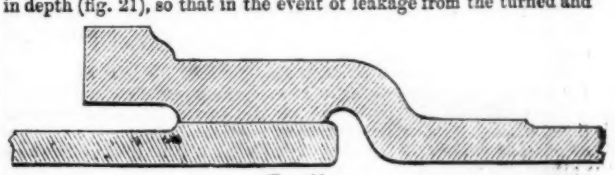


Fig. 21.

bored portion of the joint, it may be supplemented by a plugging of other materials—either lead, iron cement, or Portland cement. If the pipes are of good quality, being obtained from a manufacturer of repute, and proper care bestowed upon the boring and turning, there is no necessity for this; though it must be admitted that, in many instances, these indispensable conditions as to quality are not observed.

(To be continued.)

FRENCH PRACTICE IN THE CONSTRUCTION OF GASHOLDERS.

By M. Arson, Engineer-in-Chief of the Paris Gas Company.

[Translated expressly for this Journal by Dr. W. Pole, F.R.S., Mem. Inst. C.E.]

(Continued from page 52.)

Bell of a Telescopic Gasholder.

Various considerations determine the use of telescopic gasholders; such, for example, as want of room, or the defective nature of the ground, which does not permit of the construction of deep tanks.

The Throat or Lute Ring (Gorge).—It is well known that the two vessels which constitute the bell of a telescopic gasholder are connected by a lute or water-joint ring, which forms a continuity between them. This water-joint ought to have sufficient height to establish an equilibrium between the internal and external pressure; it ought further to have an excess of height to allow for the irregularities in level of the lute during the movement of the bell; and finally it ought to contain a further quantity of water to provide for any leakage, and for the loss by evaporation on hot days.

The fulfilment of these conditions cannot be subject to fixed rules; they will vary necessarily with the conditions of the gasholder; but the two first ought to be observed with rigorous exactitude.

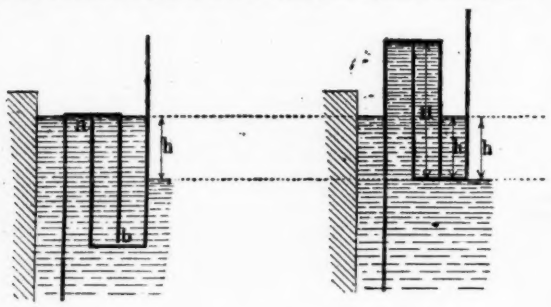


Fig. 1.

Fig. 2.

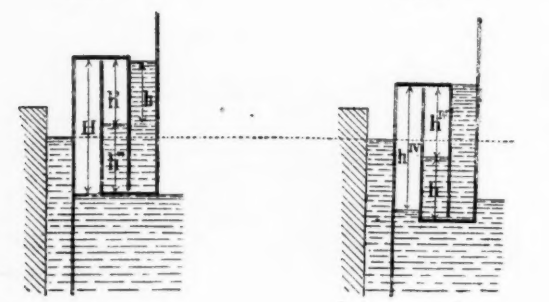


Fig. 3.

Fig. 4.

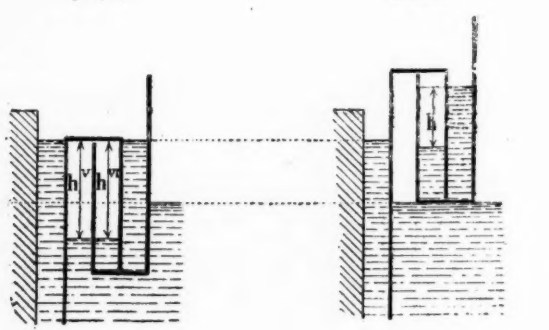


Fig. 5.

Fig. 6.

Figs. 1, 2, 3, 4, 5, and 6 represent different positions of the water-joint, and will show the different conditions which it ought to satisfy.

Fig. 1 represents the lute entirely filled with water in all its parts, as may happen either by the absorption or the leakage of the air it contains.

Fig. 2 supposes the lute with its whole height just raised above the level of the water inside the holder, but the gas not having yet entered it to displace the water.

Fig. 3 shows the distribution of the liquid in the lute, as soon as the gas has entered it, acting on it with the internal gas pressure.

The conditions of equilibrium give rise to the following observations, which establish the necessary relations between the volumes of gas and water. Supposing the section of the lute everywhere uniform, the volumes will be proportional to the heights. Hence the volume of water contained in the lute may be represented (fig. 2) by

$$H + h. \qquad (1)$$

The volume of the gas, $H + h^{i}$, shown in fig. 3, will be—

$$H + h^{i} = \frac{3}{2}H \qquad (2)$$

which shows, as a first deduction, that if the height, H, is not equal to $2h$, the water will run over the top of the lute as soon as the gas penetrates into it.

With the lute in the position shown in fig. 3, the bell may rise and fall without any change until it begins to be immersed, so imprisoning the volume of gas it contains. This immersion will give rise to new effects as follows:—

Fig. 4 represents the lute so far immersed that the water in the part open to the atmosphere has reached the level of the top of the lute. In this case the height, h^{iii}, which the gas occupies above the water in the middle compartment, is deduced $= H - h$; and the height, h^{iv}, above the surface of the water in the outer compartment, will be—

$$h^{iv} = \frac{H}{2} + h$$

Fig. 5 supposes that the bell has continued to fall—that the excess of water has fallen over into the tank—and that the lute is on the point of entire immersion. In this case, the volume of the gas is subject, in both compartments, to the same pressure; the two heights, h^{v} and h^{vi}, are equal to each other, and

$$h^{v} = h^{vi} = \frac{3}{4}H$$

This relation of the two levels will be maintained as long as the bell descends. Supposing, then, the ascent to recommence, the lute will only carry up a volume of water $= \frac{5}{4}H$, which ought to be enough to assure, in the ordinary service, the margin necessary for the other conditions, which the process of working, and the imperfections of the construction may demand—especially to secure the efficiency of the joint in the oscillations of the bell between its guides.

Effect of the Bell being out of Level.—It is, of course, assumed that the lute-ring remains constantly horizontal; but this result is not always attained in practice. It may either be out of level by defective construction, or it may get so by a movement of the entire bell.

It is further necessary to leave some play between the rollers and the guide-bars, and this cause alone will cause some obliquity of position. For example, taking the dimensions of the telescopic gasholder at St. Denis, which has the following dimensions:—

	Mètres.	Feet.
Height	14·18	= 46·5
Mean diameter of the lute-ring	19·65	= 64·5
Play between the rollers and the guides.	0·015	= $\frac{6}{10}$ of an inch.

it is found, by a simple calculation, that the difference of level between the two opposite sides of the ring may amount to 0·0414 mètres = $1\frac{6}{8}$ inch.

For this reason it is necessary that the lute should be this amount

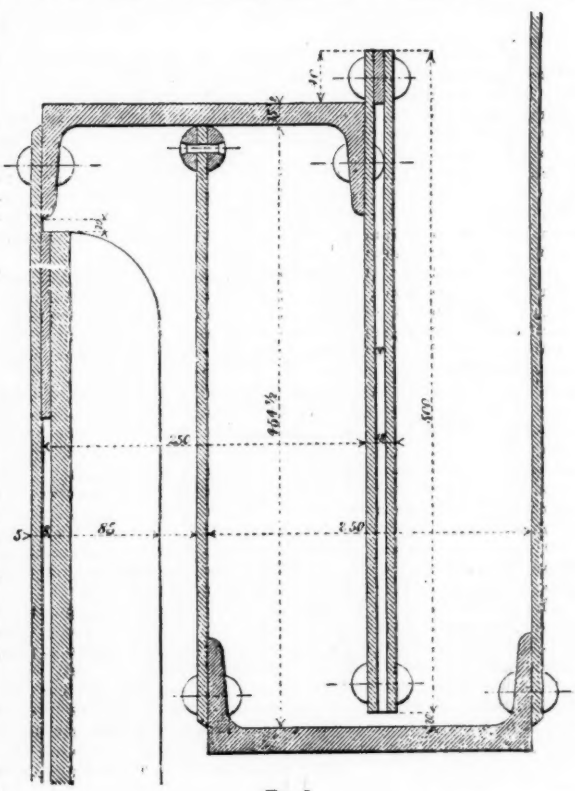


Fig. 7.

deeper than is given by the foregoing calculations. To this must be added an allowance for the risks of imperfect workmanship, evaporation, &c.; and for all these reasons combined the lute has been given a total depth of 0·50 mètre (19¾ inches), as is shown in fig. 7.

Height of the Lower Portion of the Bell.—The hydraulic lute must necessarily plunge into the water, when the lower portion of the gasholder rests on the bottom of the tank, otherwise the upper portion could not act properly.

This condition of complete immersion may even be exaggerated with advantage, and it is very advisable to oblige the lute to descend a little below the ordinary water-level. In the first place the action is better protected against evaporation, or accidental leakage of the tank, and, further, it is less exposed to freezing, which is a grave inconvenience. A submersion of a few décimètres [a décimètre is about four inches] will suffice to protect the lute, and the space thus left free is very useful, in order to allow of the upper guides being attached to the side of the bell, where they are much better placed than on the crown.

Utility of the Volume of Water in the Tank.—The freezing of the water in a tank is evidently retarded by its relative quantity. If the volume is large, frosts of short duration will not have time to lower its temperature so much as if the quantity were smaller. Hence, in cold countries, it is of importance not to diminish the capacity of the tank, as is frequently done.

Warming the Lute.—It is not sufficient to put the lute out of the way of the cold when it is down; it is necessary to adopt some means of preventing its freezing when it is elevated above the tank.

Two modes are employed for this purpose. One is to enclose the entire gasholder in a large closed building, the air of which is kept warm; the other is to warm the water in the lute when it is liable to freeze.

The last method, in order to be effective, requires special arrangements, and those adopted at St. Denis have been perfectly successful. One of the sides of the lute is double, leaving a space, into which steam can be introduced (see fig. 7). The condensed water mixes with the water in the lute, and the whole of the heat is utilized.

The number of points by which the steam is introduced should be such that it will spread itself equally; and it is found that a temperature of 10° cent. (18° Fahr.) above that of the surrounding air can be easily obtained over a space of 60 mètres (nearly 200 feet), *i.e.*, 30 mètres on each side the point of introduction.

The extremity of the heating compartment must be kept in full communication with the atmosphere, to allow the air to escape, and to prevent any inconvenient effects by condensation.

Construction of the Gasholder Bell.

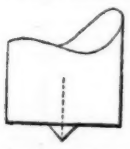
The construction of gasholder bells is a special kind of iron-plate work, on the peculiarities of which it is desirable to make some remarks.

The cost of such work may be much diminished by introducing into the manufacture certain simplifications which the Parisian Company apply with success, and which experience has fully confirmed. The most important consists in the entire preparation of the work at the manufactory, nothing being left to be done on the site but the rivetting together.

All the sheets should be cut at the iron-works, according to a template furnished with the order, so that there will be no necessity to retouch any one of them, or to have any trouble as to the place they will occupy. One single template will suffice for the whole of the side-sheets, and one for each row of the sheets in the crown.

These templates are formed in duplicate at the gasholder manufactory, before the order is given. They are oil-painted white, numbered in red, and are thus distinguished from the actual plates themselves. The crowns of large gasholders may all be designed and cut out to a spherical surface of fixed radius, and for this reason the same templates will serve for all diameters. The last ring only, which is connected to the angle-iron, will require to be adjusted to suit the diameter. A radius of 200 mètres (650 feet) will suit all gasholders from 20 to 60 mètres (65 to 200 feet) in diameter. Below 20 mètres, it is necessary to diminish the radius, in order to increase the sphericity; above 60 mètres, the sphericity may be diminished, in order to reduce the useless volume of the crown, and the expense to which it gives rise.

The duplicate series of templates are preserved at the workshop, and are marked, divided off, and punched with the greatest care, in order to serve for marking the plates to be worked up. The best way of doing this is by a punch which has the diameter of the hole, and which carries at its centre a short blunt point, sufficient to produce an appreciable mark with a slight stroke of a hammer.



The punch of the punching-machine carries a similar point, which the workman causes to coincide with the mark made on the plate.

Punching the Plates.—Punching-machines which ensure perfect accuracy, whether in the alignment of the holes or in their spacing, will answer well enough for the side plates, and for the two straight lines of each crown plate; but the punching of the holes for the circular joints of the crown plates ought to be done by hand.

Flattening.—When the plates arrive at the gasholder factory, they are flattened by hammering on thick cast-iron anvil-tables.

After this they are marked and punched, and then the side plates are curved; making the curvature a little greater than is necessary, as the transport and manipulation tend to flatten them again.

Rivetting.—In spite of the care with which these directions may be followed, it may happen that the holes do not exactly correspond, and that the steel drift tool, passed in before the rivet, will not make them coincide. This defect should be corrected by the malleability of the rivet. The rivets ought to be made from iron which is very malleable, and may be hammered cold into irregular shapes. Swedish iron is the best for this purpose, and when it is considered how small a proportion the rivets form of the cost of a gasholder, there should be no hesitation in using the best possible.

Angle-Irons.—These are of rolled iron, and should be punched and bent by machinery. The curvature may be given by hand, by blows with the hammer, but this plan is costly and defective. The Parisian Company have had a special machine made for the purpose, something like that used for bending wheel tyres; but differing in that the rollers have grooves corresponding to every class of angle-iron used. The large angle-iron of 104° is bent by this machine.

Erection.—All the parts of the bell of a gasholder ought to be put together at the manufactory, piece by piece. Work in sections—*i.e.*, the junction of several sheets together—leads to objectionable defects in shape. Perfect form can only be obtained by every sheet being prepared at the workshop.

Further, the rivetting ought not to be begun till three rows of sheets at least are put together. Little bolts, having nuts with ears, ought to be used on this temporary fitting.

The play which exists in a mass composed of such a large number of pieces renders it possible to bring accurately to their places the sheets in which the holes have been previously made to carry the frames of the guide-rollers. Of course, the bottom angle-iron and the first row of sheets must be correctly placed in their proper positions.

The diameter ought to be accurately obtained by putting the whole of the circumference together at once, and should not be deduced by offering them together in separate portions. If, on beginning the erection, any correction is necessary to one of the pieces of the base, it should be done without hesitation, rather than alter the proportions which have served for the design of the whole structure.

The interposition of paper or of paint in the joints is not necessary; a well-executed work can and ought to dispense with this contrivance, which, after all, only assures the tightness of the joint in the first instance, and which may subsequently lead to disastrous consequences. The oxidation of the metal in the joints (which are not so close as to exclude the water) will complete the tightness, which may not have been produced by the rivetting.

During the erection of the crown the sheets that are put together before rivetting are supported by stays fixed to the planking. They may be multiplied, if necessary, taking care not to overload the timber in any one place. This accidental load, however, although temporary, may possibly attain a large amount, and it demands the use of framing and planking sufficiently strong to withstand it.

(To be continued.)

Reduction in the Price of Gas.—The directors of the Scarborough Company have announced a reduction in the price of gas to 4s. 2d. per 1000 cubic feet, the reduced price to commence from the 1st inst.

Testimonial to Mr. James Watson.—On Wednesday last, Jan. 10, at noon, Mr. Henry Robus, the foreman, and all the workmen who could conveniently be present, went through the pleasing ceremony of presenting a splendid testimonial to James Watson, Esq., late engineer and manager of the Crystal Palace District Gas-Works, at his residence, adjacent to the works, Lower Sydenham. The testimonial consisted of a handsome silver bread-basket and kettle, with stand and spirit-lamp affixed, bearing suitable inscriptions, with an address expressing their heartfelt sympathy for him in his affliction, and their deep regret that he had to resign his appointment through ill-health.

Llandaff Water Supply.—At the monthly meeting of the Cardiff Rural Sanitary Authority on the 10th inst., Mr. South, the engineer for the Cardiff Water-Works Company, laid before the board a plan by which it was proposed to supply the city of Llandaff with water. The water would be pumped from the river Ely into a reservoir some feet higher than the houses in the city, and then it would be conveyed there by means of about a mile of earthen pipes. They were willing to carry out the work, provided that the authority would guarantee them a rental of £400 per year for seven years. At the expiration of that time the water-works company would take the water supply in their own hands, and depend on the income they would receive from the water-rents collected in the city. The plan was generally approved of, and Mr. South was requested to formally prepare the agreement, and submit it to the next meeting.

Barbadoes Gas Company.—The *Barbadoes Globe*, of the 21st ult., in its account of the Agricultural Society's Annual Exhibition during the previous week, remarks that "Mr. Moorhouse, the enterprising manager of the gas-works, occupied a department of the hall with some models of gas-fittings and meters, and exhibited a stove of his own invention. There was also a display of manures from refuse lime, and used in gas manufacture, which is worth the attention of the planter. This department formed an attractive feature in the Exhibition. There were some prodigious beans, grown in the yard of the gas company's works, in Bay Street—a good specimen of the nutritive properties of the manures from gas manufacture refuse, which the manager desires to introduce to the notice of the planters." The *West Indian*, also speaking of the Exhibition, says: "The chief novelty and a centre of attraction was the corner appropriated to the exhibition of gas, and occupied by the Barbadoes Gas Company, represented by their engineer, Mr. R. K. Moorhouse. It consisted of various articles of interest to all classes, both young and old. First was the 'Model Parlour Gas-Stove,' illustrating the combustion of gas at a moderate heat. Then came the mechanism of dry and wet consumers meters in glass cases, which, when at work, drew a crowd of admiring spectators. The art in works of brass—by Messrs. W. Blews and Sons, of England and Moscow—was favourably displayed. Punch smoking a cigar, and a prancing horse, driving out sparks of fire from its nostrils, were a special attraction and treat for the young folks. An experimental meter with clockwork—a piece of perfect workmanship, was calculated to afford information concerning the mode of measuring the consumption of gas. The excellent quality of coke, and tar and other products, were objects to the planters and others for their practical uses. As there were no prizes offered for this class of products, the judges unanimously made 'honourable mention' of them."

Correspondence.

PRICE OF GAS AT PRESTON.

SIR,—Allow me to call your attention to an error in your JOURNAL of the 9th inst.

In alluding to the price of gas at Preston, in your "Circular to Gas Companies" you say, "The company have now resolved to reduce the price to 3s. 9d. per 1000 feet, allowing the same discounts, which makes the cost 3s. 6½d. for small, and 3s. 4d. for large consumers." These prices ought to be 3s. 2¼d. and 3s., as you will see, if you take off the discounts of 15 per cent. and 20 per cent. The last prices before the reduction were 3s. 6½d. and 3s. 4d.

HENRY GREEN,
Gas-Works, Preston, Jan. 12, 1877. Engineer and Secretary.

BUENOS AYRES GAS SUPPLY.

SIR,—Respecting the paragraph, under above heading, in your number of the 9th inst., I beg to say that the "Mutual," *alias* "Buenos Ayres Gas Company, Limited," having given, and continued giving, credit, knowing the Municipality to be insolvent, they are not, I think, entitled to recover till the old company have been paid in full. The *Buenos Ayres Standard* of the 31st of October says :—

"The final collapse of the Municipality is the talk on 'Change. For many years this corporation has been embarrassed, and struggling with difficulties, which no meeting of creditors, no arrangement with creditors, no loans from bank, Government, or Legislature, could overcome, and the drop scene fell on Tuesday, when the bailiffs from the court entered with an execution in their pockets for 20,000 dols. m/c, with the court order to embargo the very cash in the municipal office. The assembled municipales, with breathless astonishment, heard the order of the court read, and refused, unless force were used, to give up what they termed public money; recurrence was then made to the court for public force, and to-day the bailiffs, with policemen and soldiers, seize the municipal cash-box of this city. In presence of such a judicial indignity, the municipal members have determined to lock up the premises and send the keys to the Government, but all this will not save them; the embargo must be carried out. Let us all admit that this monstrous municipal humiliation is a blessing in disguise, and from the tablets of Buenos Ayres let the name 'Municipality' be for ever effaced; could we even blot from memory the very recollection of this board, so best. But, unhappily, the citizens will, for one, or two, or three generations to come, have the most unpleasant reminiscences of this most desperately effete board, in the shape of debts piled upon debts, bonds, mortgage coupons, claims, executions, protests, and all the records of a bankrupt board. Nine years ago we advocated the closing up of this board, and the Municipality took an action against us, but the *Standard* gained. Had we succeeded, however, in shutting up the board, then millions would have been saved to the citizens of Buenos Ayres."

LOUIS WILDE,
Agent for the Buenos Ayres Gas Company.
4, *Cable Street, Liverpool, Jan.* 13, 1877.

GOATS ON ASS-MAKING.

A correspondent, who signs himself "Billy-Goats," sends us the following notes :—

ON NAPHTHALINE.—This is the *pons asinorum* of the gas manager. The cause of its production is not very *clear*, notwithstanding the fact of its being a *crystalline* substance; but when it does make its appearance it is *thar*.

The name is probably derived from Naphthali, one of the sons of Jacob; indeed, it is said by some to be the "geist" (gas), or spirit, of that lost tribe. We are inclined to give full credence to this alleged derivation, from the fact of naphthaline being a kind of *wandering dew* that settles in odd corners, growing rich and amassing substance at the expense of its neighbours.

Naphthaline is often deposited on any roughnesses in the main—entirely blocking up the passage at times. When this is the case, naphthaline may be said to rule the main; this may be considered a new version of the old mythological saw, "Neptune rules the main."

Naphthaline is also frequently to be found at or near a joint or an elbow. The greatest Nap of the family that bears that name once found himself at *Elba*, and it was unfortunate for him that he did not re*main* there.

Naphtha (first cousin to the other) dissolves naphthaline; but a gas rich in hydrocarbons prevents its deposition. The proper logical inference, then, for the gas manager is, "Look to the quality of your gas, and don't be caught *napping*."

ON KEEPING GAS IN CONTACT WITH TAR.—The ancient adage informs us that "we cannot touch pitch without being defiled." This ought to have occurred to the gas manager who first proposed the keeping of the gas in contact with the tar as long as possible. He deserves tarring and feathering for the oversight. However, he is (s)tarred already in the pages of a contemporary, the feathers being all monopolized by the artist who *plumes* himself on having exploded this other folly of the (g)ass fraternity.

ON THE PURIFICATION OF GAS FROM CARBONIC ACID.—There is a mine of wisdom in these old sayings, that gas managers would do well to fathom. "Take a hair of the dog that bit you," embodies the whole philosophy of the process of the removal of sulphide of carbon. It is the lime which has been fouled with sulphuretted hydrogen that takes out this latter impurity; but unless you first extract the carbonic acid, all your efforts to remove the sulphide of carbon will be of no avail—indeed, you will have more at the end than the beginning; it will crop up on its exit from the last purifier, like the clown at the pantomime, with "Here we are a gainer;" and pantaloon, the gas manager, will have to bear the brunt of all his mischievous tricks. Asinine as ever! You have looked upon the CO_2 as of no moment, although, of all the impurities, it is the one you have most need to get rid of.

BARTON LOCAL BOARD DISTRICT GAS SUPPLY.—At the meeting of the board on the 9th inst., at the offices, Patricroft—Mr. Henry Leigh, J.P., presiding, the question of the gas supply was considered—and it was resolved that the clerk should write to the town clerk of Salford, and say that as the Corporation of Salford were not prepared to supply them with gas without going to a considerable outlay, the corporation should allow the board to make their own gas.

Parliamentary Intelligence.

GAS AND WATER BILLS, 1877.

Memorials, complaining of non-compliance with the Standing Orders in the cases of the following petitions for Bills, were deposited in the Private Bill Office before the 9th of January :—

Bolton Improvement Bill from John Bromley and others.
Bristol District Water Bill from Bristol Water-Works Company.
Bromsgrove, Droitwich, and Redditch Water Bill from R. L. Freer and others.
East Worcestershire Water Bill from H. Hodson and others.
Limerick Gas Bill from Henry White and William Hanson.
North East Worcestershire Water Bill from A. Lucas and others.

Legal Intelligence.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

THURSDAY, JAN. 11.
(*Before Vice-Chancellor* BACON.)

THE CORPORATION OF BLACKBURN *v.* THE GUARDIANS OF BLACKBURN.
POLLUTION OF WATER AT BLACKBURN.

Mr. KAY, Q.C. (with whom was Mr. STIFF EVERITT) in this case moved for injunction to restrain the defendants, who are the rural sanitary authority of Blackburn, from causing or permitting, directly or indirectly, sewage or filthy water to flow into the natural stream or water-course, called Higher Croft Brook, or the Fish Moor reservoir of the plaintiffs, or any dyke or ditch communicating with them. The reservoir was the property of the plaintiffs, who, by certain local Acts, have the right and power to supply the town of Blackburn with water.

Mr. RIGBY, for the defendants, said that the nuisance was now abated, and his clients were in a position to give an undertaking to continue the abatement. Under those circumstances he did not think there was any necessity for an injunction.

Mr. KAY saying that an undertaking did not run with the land, and that the persons who gave a personal application would in time die,

His LORDSHIP granted the injunction in the terms asked for, with the costs of suit.

WARWICKSHIRE QUARTER SESSIONS.—WEDNESDAY, JAN. 3.

(*Before Mr.* W. DICKENS, *Chairman; and Messrs.* CALDECOTT, P. DICKENS, *and* SALE.)

THE CORPORATION OF BIRMINGHAM, *Appellants, v.* THE PARISH OF SHUSTOKE, *Respondents.*
RATING OF THE BIRMINGHAM CORPORATION WATER-WORKS.

Mr. A. YOUNG, Mr. COLMORE, and Mr. GRIFFITHS appeared for the appellants; Mr. DUGDALE, Mr. SODEN, and Mr. FITZGERALD for the respondents.

Mr. DUGDALE, in opening the case for the respondents, said this was an appeal by the Corporation of Birmingham, as proprietors of the water-works for supplying that town, against the assessment of their reservoirs, filter-beds, engine-houses, and other premises situated near Whitacre Junction, in the parish of Shustoke. These covered an area reckoned at about 30 acres, the gross estimated rental being taken at £5350, and the net rateable value at £4280. These works were constructed on the most approved principles, with the very finest machinery, under the powers of the Birmingham Water Act of 1870. They were constructed by the Birmingham Water-Works Company, from whom they had been acquired by the corporation. There were two magnificent engines, perhaps two of the finest in England, each capable of pumping four millions of gallons of water per day. There was a reservoir of 10 acres, which was embanked all round, and lined with concrete, and there were six or seven large and admirably-constructed filter-beds. The works were about the best specimens of water-works that could be found in England. There were also, in the parish with respect to which the rate was laid, 39 chains 77 links of inlet-mains, 4 feet in diameter, by which the water was conducted from the river Blythe to the reservoir and filter-beds, and about 71 chains of outlet-mains, 3 feet in diameter, by which the water was pumped up to Birmingham. The land was rated not only as land, but for the water upon it, by which its value was enhanced. The works were not finished until late in 1875 or early in 1876, and it was not until then the parish officials took steps with regard to making an assessment upon the works. The corporation did not object to the first rate; but upon that fact he would not place much stress, as they and the company were busily engaged at the time promoting a bill in Parliament for transferring the works to the corporation. A new valuation of the property in the Union of Meriden, where this property was situated, was ordered in 1875. In March of that year, Mr. Cooper, valuer, of Birmingham, who had been employed to value the works at Aston, was employed to make a valuation of these works. He made an estimate accordingly, and 5 per cent. of that sum was given by him as the gross rental, and 4 per cent. as the rateable value. The value of the property he made out to be £150,689 12s. 4d., and after making certain deductions, he calculated upon that basis the value of the property as rateable. After this Mr. Cooper placed himself in communication with Messrs. Fowler and Son, auctioneers and valuers, of Birmingham, who acted for the appellants, and who in the course of some letters (which were read) said he considered the estimates too high. After this, of course, he (Mr. Dugdale) must throw Mr. Cooper over. The question was how could the Court arrive at the value of the works. What would a tenant give for them, with their capacity for supplying water to Birmingham? Surveyors were usually employed to make estimates of the value of such property. Property of the kind was always subject to be altered by circumstances, and, consequently, no royal road for arriving at the value of any hereditament of the kind could be laid down. The superior courts of law and Parliament had refused to lay down any such road, and, consequently, the sessions had to find the value. In this case, however, there was a circumstance which would far outweigh the evidence of any valuer. It so happened that the value had been determined by the appellants themselves. They, in 1875, went to Parliament for a bill to buy the whole of the undertaking of the Birmingham Water-Works Company, and he believed the result was that the corporation gave water annuities for the maximum dividend, payable on the capital called up by the company. If the Court, then, could find out, at any rate approximately, what was the amount of the capital of the company which was due to these water-works, they had a very easy mode of determining what the appellants themselves considered to be their annual value. Up to 1870 they had raised £420,000 of capital, carrying 8 per cent. interest. He believed in 1866 the company were allowed to raise £336,000 capital, at 7 per cent. interest. The £420,000 was all spent in 1870. When they got the amount of capital expended by the company on these works, and took it at 7 per cent., the rate of annuity paid by the corporation, they would find what the appellants considered to be the real value of the place. The Shustoke works were an integral part of the valuable works of the company. If, therefore, they took 7 per cent. on the amount of the capital spent on

these works, they would be doing a very handsome thing, as they really ought to rate the appellants at a great deal more. In order to do this they would have to find out how much of the capital had been sunk in these works, and they could only do that from the books. These annuities were in the nature of a perpetual rent, and the corporation paid so much as perpetual rent for the works. What was the difference, in a case of this kind, between a perpetual rent and what a tenant would give? If anything, it was in favour of the corporation, because the works were increasing in value year by year. Every year the demand for water in Birmingham was increasing, and every year the corporation had to increase their capacity for supplying water. Therefore he submitted that this part of the undertaking was one of the most valuable parts of the works of the corporation, and that the perpetual rent which they agreed to pay in 1875 was not likely to be diminished by a tenant, but increased. Taking the appellants own figures—Mr. Fowler's figures—the sum of £76,515 19s. 5d. was the amount spent on the works; and that, at 7 per cent., gave £5235, which would more than support the rate. This £5235 was what he should call the net rent, because the appellants gave it, themselves paying all expenses of working and maintenance, and all the money necessary for keeping the hereditament in a state to command the rent. The principle he had spoken of, he submitted, would outweigh the theoretical calculations of any and every surveyor in England. It might be that the rent paid was too little, but of course the Assessment Committee were bound to look at the actual value of the premises. What, however, could be better evidence than the fact that the appellants themselves had given it so very short a time ago? It was eminently fair to take it as the value, because the corporation had splendid works. They had been enabled during the last half year, so prosperous were they, to pay all the water-works annuities, and they had a small surplus. They therefore got the immense amount of water the town required for nothing. If that was not a sagacious and prudent purchase, he did not know what was. He expected nothing else when he knew that the two gentlemen most prominent in the negotiations were Mr. Chamberlain, M.P., and Alderman Avery. They had previously purchased the gas-works, and they were conducted so sensibly that in the first year a profit of £30,000 was made, and the price of gas reduced. If he might pay a tribute to Mr. Chamberlain, he should say he was a Liberal in politics and a Conservative in finance. Alderman Avery was no less sagacious in financial matters, and he would show, from a speech made by that gentleman, that he had congratulated the town on the acquisition of these works. He might also call attention to the fact, as a further proof of the value of the property, that on the land upon which the reservoir and filter-beds were constructed there were all the materials—clay, sand, and gravel—required. Moreover, under the Act of 1875, the corporation could supply water for the Local Boards of Aston and Handsworth, and yet they do no works for these purposes on which the local boards did not pay interest at 6 per cent., so the corporation valued their property at that rate themselves. The profit of the whole undertaking for the last half year amounted, according to the report of the Water-Works Committee, to £47,712 for payment of the annuities, and £7950 for interest on mortgages for the year. So the appellants were making £55,000 a year, while their total rateable value was only £23,000. In fact, he believed the appellants were underrated, and he trusted the Court would think it was quite clear, not only that they were not overrated, but that the respondents had more than amply supported their rate.

Mr. *Arthur Seymour*, examined by Mr. SODEN, said in January, 1875, the Assessment Committee of the union which included the parish of Shustoke decided that a new valuation of the property of the union should be made. In March of that year Mr. Cooper, who had valued the water-works at Aston, was appointed valuer to assist the overseers in making the valuation of the works. On the 3rd of August the overseers brought in a draft of the valuation list, in which the works were valued at a gross rental of £6786, and the net rateable value at £5420. Subsequently the overseers found that two cottages had been included, and the figures were altered to £6740 gross value, and £5392 net rateable value. On the 12th of July the rate was made on the latter amount, and he heard nothing more of the matter until he received a letter from Mr. Fowler on the 24th of February. The Assessment Committee gave Mr. Cooper no authority to place himself in communication with Mr. Fowler. Mr. Fowler and Mr. Cooper attended a meeting of the committee on the 29th of February, and after that a number of letters were written from one to the other. The committee decided, at an adjourned meeting, not to disturb the estimate. He wrote to Mr. Fowler, asking for further information, which was declined. Mr. Cooper's reason for making a reduction in the rateable value was stated, in a letter to him, to be that some of the mains outside were included in his original estimate. He had had a correspondence with Mr. Hayes, the town-clerk, asking for information as to the value of the property, but had failed to get what he required.

Mr. *W. Starkey*, examined by Mr. DUGDALE, said he was secretary of the Birmingham Water Company for 22 years, and still retained the office under the corporation. He produced the books containing the amount of the cost of the works included under the Act of 1870. [Witness was examined at some length upon the accounts, and, as it appeared certain that the case could not be concluded that day, an adjournment was agreed upon until the Friday. It was further resolved that Mr. Castle, of Chancery Lane, London, valuer on behalf of the respondents, and Mr. Hedley, of Sunderland, on behalf of the appellants, should examine the books at the water-works offices, on the following morning, so as to be able to give evidence concerning them.]

FRIDAY, JAN. 5.

At the sitting of the Court,

The CHAIRMAN inquired whether there was any principle upon which they were agreed.

Mr. DUGDALE: We cannot agree upon any principle, because there is not one.

Mr. YOUNG: I do not agree to that. There is an admirable principle. It is that of *The West Middlesex Water Company v. The Parish of Hampton*. The whole principle is there, and I intend to bring my case within it.

Mr. DUGDALE: My case is within it. The question is what a tenant from year to year would give.

The CHAIRMAN: I did not know whether you might have taken the original outlay as the basis of the valuation.

Mr. YOUNG: Mr. Castle and Mr. Hedley have gone through the books, and they have agreed on the outlay.

Mr. DUGDALE: A great deal of time has been saved, but we cannot agree as to the per centage which is to be put on.

The CHAIRMAN: Do you agree upon the basis on which the per centage is to be calculated?

Mr. YOUNG: No.

The CHAIRMAN: If you had agreed to anything we would get to the point at once.

Mr. YOUNG: My friend himself put forward three suggestive principles, and as I do not know upon which he means to rely, I cannot agree with him at present.

Mr. *Henry J. Castle*, examined by Mr. DUGDALE, said he was senior partner in the firm of Castle and Son, of Chancery Lane, London, and had had 36 years experience in valuing land, railways, water-works, &c., for rating purposes. On the previous day he and Mr. Hedley visited the offices of the water-works at Birmingham, and went through the books. The result was that they had agreed upon the following joint report:—

Birmingham Water-Works Appeal.

In accordance with the agreement made on Wednesday, we met at the Birmingham Water-Works Offices, Broad Street, yesterday morning, and examined the books of accounts containing the entries of the amounts paid for the water-works at Shustoke and Whitacre. We also examined the deeds conveying the lands purchased for the said works, and we annex the several particulars.

1. Total expenditure in respect of the whole works. 2. The area and expenditure for the lands purchased. 3. The area of the land occupied by the works in the parish of Shustoke, and the capital expended in the parish of Shustoke upon such works. 4. And the accounts paid for law charges and compensation.

We had every facility afforded us by the appellants officers, Messrs. Gray and Starkey, and the fullest explanation was given upon all points.

(Signed) THOS. F. HEDLEY, for the Appellants.
J. H. CASTLE, for the Respondents.

The first schedule upon which they were agreed was one showing that the total expenditure in the parishes, professional charges, compensation, &c., down to the 31st of December, 1875, was £157,175 4s. 4d. Included in this was the sum of £11,830 7s. 1d. for mains, which consisted of 1000 yards of 48-inch mains, and 1500 yards of 36-inch. The area of land occupied by the works was 30 acres 26 poles, and the capital expended on that land in the parish of Shustoke amounted to £71,482 17s. 5d. The site of the works consisted of two properties—one, 14 acres 3 roods 22 poles, bought of Mr. Dugdale, which he valued at £11,477; and the other, 15 acres 1 rood 4 poles purchased of Mr. Salmon, which he valued at £2030, making a total £13,507. For way-leave, or the privilege of laying pipes through the land of Mr. Coxall, was paid £150. These sums added together made a total of £85,140. He did not find anywhere in the books the amount expended for architects or engineer superintendent. He presumed that the officers of the company undertook these duties in addition to their own, and he had, as usual, allowed 5 per cent. upon the total cost of the works, £71,482 17s. 5d., for this commission, which amounted to £3574. He then added another item of 10 per cent., because the works were constructed at a favourable time, under favourable circumstances, when material and labour were cheap, and a saving to that amount was effected.

The CHAIRMAN did not think the amount could be included, as the money had never been spent.

Witness said he had always been accustomed to do this in cases where the building contracts had been of a favourable nature.

Mr. DUGDALE: Did you find that the works were constructed under such exceptional advantages, that they had all the materials on the spot for the construction of reservoirs and filter-beds, and did not have to bring or carry from anywhere else this material? Do you mean that a reduction should be made on that account?

Witness: No; I think that was one reason the company gave so much for the land.

Mr. DUGDALE: The witness says an addition should be made to the actual outlay, because the contracts were so exceptionally cheap.

Examination continued: The 10 per cent. upon £71,482 would be £7148, which, added to the figure already given, would make a total of £96,062. He should say that a landlord who expended that amount of money upon building would expect from the tenant a yearly net rental of £4813.

The CHAIRMAN: That is about the rateable value as according to the respondents.

Mr. DUGDALE: It is more than the rateable value.

Witness said the sum he had mentioned was 5 per cent. net on the fair outlay. The gross estimated rental would be £5811, which would be the rent paid by the tenant if the landlord had to do the repairs.

Cross-examined by Mr. YOUNG, witness said the principle upon which he always acted in making estimates of the rental of railways and water-works was to take a per centage upon the total fair outlay. The per centage he had always allowed on the expenditure as the rateable value was 5 per cent., except on one occasion in London, when for one year the per centage was put down at 4 per cent. The original practice of allowing 5 per cent. had since been returned to. He valued the St. Pancras Station; indeed, he valued all the railway stations in London, and he did not remember that he deducted a large amount from the total outlay on the ground that part of the station was not used. He should certainly have made such a reduction if part of the station only were used. He went to Shustoke on the Wednesday before Christmas-day, and was there only two hours, for he could not find the place. He found there were two large filter-beds, which cost £5775, put down in the schedule, and as these had never been used, he should reduce the total by that amount. For the land not used he would not make any allowance, as by not using the land, they did not deprive themselves of all the advantages of site for the rest of the work. The sum of £1579 19s. 6d., which was for pipes which were bought and not laid down, should also be taken off the total, for such pipes should not be rated. He should not make any allowance because the works laid down were only used to a quarter of their capacity. He did not know that the agreement between Mr. Dugdale and the company for 50 acres of land at a cost of £18,500 included the cost of his opposition in Parliament, payment of his water rights, and compensation for other privileges.

Mr. YOUNG: You said you estimated the architect's fee at £3574; but if you knew that the sum paid was only £606, that sum would be considered correct?

Witness: If the architects had no assistance to do the work.

Mr. YOUNG: The architects were the eminent Birmingham firm of Martin and Chamberlain.

Witness said if they only received £616, they did their work very cheaply in Birmingham. The land of Mr. Solomon, for which £133 an acre was paid, adjoined the land of Mr. Dugdale, and he knew no reason why Mr. Dugdale's land should be worth £200, and that of Mr. Solomon only £133. He could not say whether the larger sum was paid as the costs of his opposition in Parliament.

Mr. DUGDALE proposed to put in evidence, as showing that the Blythe was in the manor of Blythe and parish of Shustoke, an ancient document found among the papers of Sir W. Dugdale, the historian. It recorded a suit between Sir W. Dugdale and the Vicar of Coleshill, described as a "proud and stomachful person," with reference to the right of the former to cut the bulrushes on an island in the river. Sir W. Dugdale won the suit, and carried off his bulrushes in triumph. He submitted that the document in question was evidence of repute.

Mr. YOUNG thought the document showed nothing, except that his friend's illustrious ancestor claimed the river. It might be admitted for what it was worth. He, however, had a document, in the shape of a deed, under which the water-works company purchased the land in question, in which the river was shown to be in the parish of Coleshill.

This was the case for the respondents.

Mr. YOUNG, in opening the case for the appellants, said he could not help thinking that the authorities of Meriden Union and the parish officers who had been in Court during the hearing of the case must long ago have

regretted having compelled the Corporation of Birmingham to bring the matter before the Court by way of appeal, and equally have regretted that they had ignored the agreement between Mr. Cooper and Mr. Fowler. Had they acted upon that agreement they might have had their rate of so much in the pound upon £3060, which was the amount agreed upon by them. He thought they would regret not having adopted that course, because he should be able to make out to the satisfaction of the Court that the rateable value of the property in question was considerably lower. Before dealing with the figures, he wished to refer, in a supplemental way, to the history of the water-works company, which the advocate for the respondents had somewhat extensively introduced into his case. He should only refer to it incidentally, and so far as it seemed to show very grave reason why the appellants should not be rated at the excessive amount at which the parish authorities desired to assess them. It appeared that the Water-Works Company, who transferred their powers to the Corporation of Birmingham in January, 1876, went to Parliament in 1866 for the purpose of obtaining additional powers. They obtained an Act that year, by virtue of which they were enabled to sink wells at Perry Barr, King's Vale, Sutton, Edgbaston, and one or two other places, from which sources they contemplated supplying the town of Birmingham with water, Parliament having stipulated that after the execution of the new works the company should discontinue their operations under a former Act obtained in 1826. The only reason why they went again to Parliament, in 1870, when they obtained the Act for constructing works at Whitacre and Shustoke was that during the sinking of the well at King's Vale, Mr. Gray, the company's engineer, discovered that some of the anticipations which had been made with reference to the wells, were not altogether well founded. Great trouble was met with in reference to the running sand and gravel, and as it was thought similar difficulties might arise in the case of the other wells, the company went to Parliament and obtained further powers for the construction of additional works at Shustoke. As was shown by the plan submitted to the Court, it was contemplated by the company, and was still in contemplation by the corporation, to construct the works for which powers were obtained in 1870, but in point of fact they had been only partially constructed, the large reservoir for water from the river Bourne being wholly untouched at the present time. He mentioned this to show, as had appeared from the evidence of Mr. Castle, which had been supported by Mr. Gray, that those large works were constructed with a view, not to existing requirements, but to what might be required in future. The works, under the Act of 1870, were very much larger than the demands of Birmingham at the present time required. They had constructed, first of all, a reservoir capable of containing 30 million gallons of water, the filter-beds numbered 1, 2, 3, 4, 5, which were only partially in operation at the present time, and also two large filter-beds which had never yet been used at all, and the construction of which ought not to be calculated in the outlay on the works, or considered in the question of rating. The company also put down plant, machinery, engines, and boilers, sufficient to supply a very much greater quantity of water than was contemplated to be supplied, in the present state of development of the scheme, under the Act of 1870. The result of all this was that the appellants had got filter-beds now in actual use, capable of filtering 7 million gallons of water per day. They had also constructed two filter-beds, which had never been used, capable of filtering 5 million gallons. They had also laid down plant and machinery which was capable of supplying to Birmingham 6 million gallons of water per day, and they had laid down mains capable of conveying into Birmingham 12 million gallons a day, only in anticipation of the development of the scheme of water supply, which was in view when the Act of 1870 was obtained. Although they had all this extensive plant, the company and the corporation had not, from first to last, supplied Birmingham at any time with more than an average quantity of 2 million gallons. When Mr. Castle was in the box, and estimated the outlay on the works at £71,000, he (Mr. Young) asked whether in his opinion some deduction ought not to be made from the rateable value for the unemployed capacity of the works, and Mr. Castle replied that in his judgment it ought to be so. Of course it would be a matter for the consideration of the Court how far this was an element in the question before them. Mr. Gray would tell them that works capable of supplying 2 million gallons a day could have been constructed for an expenditure of £25,000. He could not help thinking that if the corporation had been desirous of contesting this matter on their strictest rights, and without any consideration for the agreement come to by Mr. Fowler with Mr. Cooper, they might have asked to be rated, not upon the basis of £75,000, but upon £25,000. He would say at once, however, that he was not going to ask the Court to take its stand upon that figure, but upon the actual outlay by the water-works company, now represented by the corporation. He thought he should be able to show that the figures he was about to lay before them were the correct figures; and if that were so, the only question of contest would be what they were to take as the per centage on that expenditure; whether it should be 5 per cent., as the respondents contended, or 4 per cent., as urged by the appellants. He now came to the rate of October, 1875. That rate was made upon inaccurate data. Mr. Cooper, who made out the valuation list for the rating authorities, went to the offices of the water-works company, and asked what was the outlay upon the works. The person who gave him the figures appeared to be under the impression that Mr. Cooper wanted the outlay not in Shustoke parish only, but at Shustoke and Whitacre, including the land for the large reservoir not yet constructed, and the figures accordingly given to him were £150,869 12s. 4d. It was now admitted that this was inaccurate, but it was upon this that Mr. Cooper acted in making the assessment for the October rate. Mr. Cooper appeared to have discovered afterwards that it was an error, and reduced the figures to £135,869. That, however, was equally erroneous. The figure which Mr. Cooper ought to have had was the actual outlay on the works in Shustoke, which was £71,000 odd. The assessment for the October rate was made at 4 cent. upon £135,869; and upon receiving notice of it the corporation instructed Mr. Fowler, their surveyor for the water-works, to put himself in communication with the person who was supposed to be authorized to make the valuation list. Mr. Fowler entered into negotiations; but it turned out that Mr. Cooper was not authorized. Mr. Cooper, however, thought that he was, and agreed with Mr. Fowler to the correction of the valuation. He asked Mr. Fowler for some figures to lay before the Assessment Committee for the purpose of justifying himself. Mr. Fowler then handed him some figures, amounting to £75,000 odd, which again were erroneous, upon the basis of which it was agreed to reduce the assessment from £6000 odd gross rental and £5000 rateable value to £4000 odd gross rental and £3060 rateable value. Owing to these negotiations the time for appealing against the October rate went by, and the corporation paid without prejudice the amount with which they were charged. Next came the rate of July, 1876, against which the present appeal was made. The appellants property was described in the assessment as "Reservoir, filter-beds, engine-house, and works, near Whitacre Junction, 30 acres, £5350 gross estimated rental, £4280 rateable value," and then £21 was added for the cottages and sporting right. This assessment was not made upon any figures of Mr. Cooper's, nor upon the £71,000 supplied as being the accurate figure, but at a valuation of £107,811 12s., upon which 5, not 4, per cent. was taken in arriving at the assessment. The figures of the respondents had not been supported by the evidence of any of their witnesses, although it had been attempted to be defended by the ingenuity of Mr. Dugdale. Even upon the figures of Mr. Castle, the assessment ought to be very much lower than it was. It was evident from Mr. Castle's evidence that the true principle on which the rate should be based was to ascertain the expenditure upon the land and works, and take a per centage on that expenditure as the rateable value. The witnesses for the appellants would tell the Court that this principle was right; but they would say that the per centage taken should be 4 per cent., and not 5, as urged by Mr. Castle. The theory of Mr. Dugdale of taking a proportionate part of the profits of the corporation on the whole of their works as a basis of valuation was utterly fallacious and repugnant to law. The case of *The West Middlesex Water-Works Company v. The Overseers of Hampton*, in the Queen's Bench Reports, was one on all fours with the present, and in that case it was clearly laid down that the Court were not to rate the works—which were situated in a parish where the water was not being sold—upon the profits obtained elsewhere. They were to take them as land covered with buildings, which had an enhanced value from its application and use for water-works. In Shustoke the land was purely agricultural, and not worth more than £2 an acre to let, and as soon as the water-works were made it had an additional value; but they were not entitled to arrive at that value by inquiring into the profits obtained elsewhere. His friend asked them to say the land had an enhanced value because the water was found in the parish of Shustoke, and not in the parish of Coleshill; but a portion of the valuable old record he put in said that, although the parishes were divided by the river Blythe, the lordships were not. That showed what a weak bullrush his friend had relied on. There was no doubt that the water was obtained from the parish of Coleshill, and if anybody was entitled to advantage from that, the inhabitants of Coleshill were. In the Amwell case, which had been referred to, the water was derived from wells which were in the parish of Amwell; whereas in this the water was derived from the river Blythe, which was not in the parish of Shustoke, but in Coleshill. In the Amwell case the water bubbling up in the wells might be considered as fixed capital in the soil; but even if the Blythe were in Shustoke, it had been established by the case of the *Tallagog Mining Company v. St. Asaph's Union* (3 Q. B., 478) that the right to take water from a running stream was a mere easement, and not the subject of a rate at all. Upon the principle of finding the value of the land and its fixed capital, and taking a per centage upon them, he would show the Court what the amount of the assessment ought to be. The first figure he took was the total outlay on the works, as in the accounts prepared between Mr. Castle and Mr. Hedley—namely, £71,482 17s. 5d. In cross-examination Mr. Castle had admitted that there ought to be deducted from this £5775 in respect of the two filter-beds not used, and £1575 for mains which were not laid when the rate was made. Deducting these amounts, there was left £64,132 17s. 5d. as the admitted expenditure on the works at Shustoke. To this had to be added the cost of the land. The land purchased for the works from Mr. Dugdale was 50 acres, of which 14 acres 3 roods 22 perches were in the parish of Shustoke. The total amount paid by the company for the 50 acres was £18,500; but Mr. Castle put down as the value of the 14 acres odd in the parish of Shustoke £11,477. How on earth such a calculation was arrived at surpassed comprehension. The value ought to be put down at the sum of £200 per acre, and even that, in comparison with other land in the neighbourhood, was an excessive price. As the appellants desired to be liberal they would put it down at £200 per acre, which would give, in round numbers, £2800 as the value of the land in the parish of Shustoke. Add to this £150 for way-leave, £2030 the price of the land purchased from Mr. Salmon, and it gave £69,312 17s. 5d. as actual cost to the water-works company of the land and works. Upon that sum a per centage of even 5 per cent. would only give a rateable value of £3465, as against Mr. Castle's £4843. Taking, however, 4 per cent. as the right principle, and the one which was adopted by the overseers in their previous assessment, it would give a rateable value of £2772, at which amount he asked the Court to fix it at.

Mr. *John W. Gray*, examined by Mr. Young, said he was the water-works engineer of the Corporation of Birmingham. He was appointed in 1866 engineer to the Birmingham Water-Works Company, and in that year the company had a bill before Parliament for an extension of their powers. This bill gave them power to sink wells at Aston, Perry, Erdington, Edgbaston, and other places. The company proceeded at once to sink a well at Aston, and another at Kingsvale. They did not obtain from these wells the water they expected, and he recommended the company to go again for additional powers. They obtained the Act of 1870, and the works at Shustoke were commenced at the beginning of 1871. In his judgment a sufficient expenditure to convey 2 million gallons from that place would be under £25,000. It was part of a complete scheme of water supply that the works at Shustoke were made so extensive, but it was afterwards found that the supply from the wells was more favourable than it was supposed would be the case, The water supplied from the Blythe had not, on the average, exceeded 1¾ million gallons per day. The water was drawn from the river within a few hundred yards of the junction of the Blythe and the Cole, within the parish of Coleshill. No water was drawn from the Blythe in the parish of Shustoke. The reservoirs and filter-beds were constructed to supply 7 million gallons per day, but the requirement was not more than the quantity he had mentioned. The two engines were each capable of sending into Birmingham 3 million gallons per day. The works had been constructed with a view to the future development of the system of water supply, and not for present requirements only. The corporation had adequate means at present of supplying the town of Birmingham with water without using the Shustoke works at all.

Cross-examined by Mr. Dugdale, witness said the company went for additional powers in 1870, because they were forced to abandon the Tame supply. The water flowing from the river into the reservoir was, when necessary, shut off at the reservoir, and not at the mouth of the pipe. Before the works were turned over to the corporation, about two-thirds only of the inhabitants were supplied with water. The remainder of the population were supplied from wells, many of which the corporation had now closed under the Public Health Act, and the persons formerly using them were now supplied with water-works water. He had no idea of the increased consumption caused by this alteration. Messrs. Martin and Chamberlain were applied to only for the buildings, and he (witness) designed the engines, and reservoirs, and works, all of which were constructed under his supervision. The cost of the buildings designed by Messrs. Martin and Chamberlain was £12,000, and the sum they were paid, £600, was 5 per cent. on that amount. He supposed the company saved the commission on the other portions of the work which he designed and superintended.

In re-examination, witness said the Blythe was tapped nowhere but in the parish of Coleshill.

Saturday, Jan. 6.

Mr. *William Fowler*, examined by Mr. Young, said he was the principal partner in the firm of William Fowler and Sons, surveyors and land agents, Waterloo Street, Birmingham. He stated that he had had 40 years experience as a surveyor in rating questions, and had been extensively engaged in the rating of canals, gas-works, water-works, &c. He was surveyor to

the Birmingham Water-Works Company from 1854, until the transfer of the powers of the company to the Corporation of Birmingham, since which time he had been surveyor to the corporation in respect of the water-works department. He recollected the rate made on the water-works property in Oct. 1875. Mr. Cooper, a surveyor of some eminence at Sutton Coldfield, was employed by the parish authorities to make the valuation list, on which the October rate was based. The amount took the corporation by surprise. Knowing that there was some grievous mistake, he saw Mr. Cooper, and told him of it. Mr. Cooper said if there was a mistake it should be rectified. Witness gathered from what Mr. Cooper said that he had been down to the water-works, and asked to be supplied with the cost of the erection of the works, and he had been supplied with the sum of £157,175 4s. 4d. That was the cost of the works in the whole of the seven parishes, and had been supplied to him, in error, as the cost of the works in the Shustoke parish only, which was what he wanted to know. It was upon that he made his valuation charge. Witness supplied Mr. Cooper with the information he required—namely, the cost of the works in the Shustoke parish—£71,482 17s. 5d. Upon the matter being explained, Mr. Cooper accepted that as the correct amount. The sum first given to Mr. Cooper by witness was £76,000 odd, but that turned out to be an incorrect sum, in consequence of some cottages having been erroneously included, and the £71,000 odd was finally accepted as the correct sum. In the first sum he included the cost of the mains laid after the passing of the rate, which was £1579 19s. 6d., and £5575., the cost of the two unused filter-beds, which, with the cottages, made the difference between the £76,000 odd first given, and the £71,000 odd finally accepted. He found that Mr. Cooper had proceeded to make the assessment by putting the gross at 5 per cent., and the rateable value at 4 per cent. upon the estimated cost of the works. To that principle witness did not object, and he believed at the time that Mr. Cooper was perfectly authorized to enter into this arrangement on behalf of the Assessment Committee of the Meriden Union. When he afterwards discovered that the Assessment Committee ignored what Mr. Cooper had done, witness was taken entirely by surprise.

The CHAIRMAN said he doubted whether the filter-beds ought to be deducted.

Mr. YOUNG said the only filter-beds they asked to be deducted were two which had never yet been used, and which could not be used until the large reservoir was constructed. They were made while the contractors were on the premises with their material and plant, which it was thought would save a considerable sum. He was not going to deny but that if these beds had been used the corporation would have been liable to be rated in a sum, but as they had never yet been used, he denied that they should be rated beyond the mere agricultural value of the land.

Witness said he had seen the valuation list upon which the rate of the 12th of July, now in issue, was based, and he had heard from Mr. Seymour, the clerk to the Assessment Committee, that it was based upon £107,000 odd. Upon examination of the valuation list, he found that the Assessment Committee had adopted, in that rate, the principle of assessment upon which he and Mr. Cooper had agreed—namely, 5 per cent. upon the cost as the gross value, and 4 per cent. upon the cost as the rateable value of the property. That principle he regarded as the right one. In point of fact, the only error in the assessment was that the committee had taken £107,000 odd as the cost of the works in Shustoke parish; this, the initial figure, was wrong, but the principle of 5 per cent. and 4 per cent. for the gross and the rateable values was right. He agreed that the figures elicited in the course of this trial—£69,312 17s. 5d.—represented the proper amount upon which the works should be rated. Taking it in round numbers 5 per cent. upon that sum would represent the gross annual value at £3465, and deducting for repairs 1 per cent., it would leave £2772 as the rateable value, or 4 per cent. It had always been his experience to put 5 per cent. for the gross value and 4 per cent. for the rateable value. The capital figure—namely, the cost of the property, was a matter that always required care in determining it, as it varied. In this case, the works having just been erected, and including all modern improvements, he considered it fair to take the actual cost incurred as the capital figure upon which to base the gross and rateable values. Supposing it was the case of some works which had old-fashioned and exploded appliances, the value would be less. He was intimately acquainted with the land upon which these works stood, and settled the draft agreement for the purchase of the same. The price paid to Mr. Dugdale for the land he surrendered—£200 per acre—included other matters than that of land merely. The purchase-money included £1500 for damages to mill, and £2000 for damage to residence. There was also a sum of £5000 for the sake of peace. He could not account for Mr. Castle putting £800 as the price per acre of the land. Mr. Dugdale was at the time opposing the application to Parliament for the Bill, and they were advised by Mr. Hawksley to pay Mr. Dugdale that sum, in order that his opposition might cease, otherwise it was thought they would not be successful. The memorandum of agreement showed that the purchase-money was not confined to the land. It was as follows: "Memorandum of agreement for the settlement of Mr. Dugdale's opposition to the Birmingham Water-Works Bill, 1870. 1. In consideration of the following stipulations, Mr. Dugdale agrees to withdraw his opposition to the Bill now before the committee of the House of Lords. 2. The company to pay Mr. Dugdale, within twelve months from the passing of the Act, or sooner if they require the earlier possession of the land, the sum of £18,500 for 50 acres of land, and all damage done to his estate and mill, by the execution and maintenance of the company's works, as proposed to be authorized by the present Bill, and if a less or greater quantity than 50 acres of land be taken, a deduction from, or an increase to such sum of £18,500, is to be made at the rate of £200 per acre. Mr. Dugdale is to compensate his tenants. The company to determine and give notice to Mr. Dugdale within six months from the passing of the Act, the quantity and situation of the land they require, which must not exceed 53 acres in all." It was customary in new works to write off 10 per cent. for depreciation. It was exceptional to take the actual cost as the basis of value, but he did so in this case because the works had just been completed on the most approved principles, and were perfect in their character. During his 40 years experience he had never known, in cases like the present, a higher fateable value than 4 per cent. He had recently valued the Worcester Water-Works, which were under a special Act, at 4 per cent.

The CHAIRMAN inquired whether the estimate of the rate at 4 per cent. or 5 per cent. upon the outlay would not depend upon the success of the works.

Witness replied that it would not.

The CHAIRMAN said it appeared to him to be an erroneous principle to fix upon 4 or 5 per cent. as the basis of calculation without looking at the prosperity of the works, because a tenant might be disposed to give a higher rental for a prosperous concern than he would for one which was not prosperous.

Witness replied that for the whole concern a tenant might give more, but he certainly would not do so for the portion of the concern lying in the parish of Shustoke alone.

The CHAIRMAN remarked that nothing could be earned elsewhere without the Shustoke works.

Mr. YOUNG said that in the case of *The Chelsea Water-Works v. Putney* it was held by the Court of Queen's Bench that for rating purposes the parish could only take cognizance of that part of the concern lying within the area of the parish.

Mr. DUGDALE said he should have something to say upon this part of the case, but he quite agreed with the answer of the witness.

Witness said that, under the first assessment made by Mr. Cooper, the rating of the part of the works in the parish of Shustoke was more than the whole of the parish besides.

Cross-examined by Mr. DUGDALE, witness said that he could not state what was the total rateable value of the company's works in all the parishes. He was willing to accept the following figures as being probably correct:—Aston, gross £13,860, rateable value £11,750; Minworth, gross £1809, rateable value £1447; Sutton Coldfield, gross £84, rateable value £67; Handsworth, gross £230, rateable value £200; Perry Barr, gross £520, rateable value £450; Edgbaston, gross £1370, rateable value £1143. There were several other parishes the aggregate value of which might be slightly under £20,000. It was correct to say that the value of the works was what a tenant would give them.

Mr. DUGDALE: Suppose a tenant, instead of your 4 per cent., gave 5, 6, or even 7 per cent., what would you say then?

Witness: I should think he ought to be sent to Bedlam.

The CHAIRMAN: You would never send him there for that.

Mr. DUGDALE: But if a man is foolish enough to give 5, 6, or 7 per cent., then it should be valued accordingly. The net amount is what a tenant would give.

Witness: I am quite sure you would not find a tenant to give it. I am quite as sure of it as I am of being in this box.

Mr. DUGDALE said that if a tenant paid more for a house than its value, the rent could be taken as its rateable value.

Witness said it was generally assumed that the rent paid by a tenant was the minimum, but this was a case *sui generis*, and that of a house was not at all analogous to water-works. His experience of water-works was confined to the Midlands.

Mr. DUGDALE: You never came into contact with the late Sir William Bodkin and 5 per cent.?

Witness: I should expect to find great points of difference between water-works in the Midlands and such properties in London. I value Mr. Dugdale's land at £2500. Mr. Dugdale's solicitor and agent contended that there should be a large sum paid for the abstraction of the water, but the company disputed the claim, and denied that he had any right to the water. I know the sum of £5000 was paid for the abandonment of the petition, but it was very reluctantly done. They were advised by Mr. Hawksley that they would lose their bill if they did not do so. They looked upon it in the nature of black-mail to a certain extent.

Mr. DUGDALE: Did you add any value to the land in consequence of the water?

Witness: Certainly; else I should have put it at about 50s. per acre. I did not, however, value the water, but I increased the value by reason of its having a reservoir, which, whether full or empty, I should value at the same figure. For the water they take from the reservoir the corporation do not pay a single farthing. The difference between my estimate of the value of the land and Mr. Castle's is £8520. Interest at the rate of 5 per cent. upon my value would be about £585 per annum. I have not the least idea how much the corporation get per million gallons for what they sell. I was present in the House of Commons when Mr. Till, the borough surveyor, was examined. It is very likely that I heard question 398 put to him, where he was asked by counsel if he had a statement giving the quantities of water used and paid for by the corporation since 1863, but I do not recollect it. I cannot recollect that the statement handed in by Mr. Till showed that the corporation paid to the company at the rate of £25 per one million gallons. I do not know that the profit of the last year was sufficient to pay the whole of the annuities, but I know the concern was very prosperous.

Re-examined by Mr. YOUNG: I do not know of any reason why the Shustoke water-works should be rated as suggested by the other side; it is quite contrary to law, practice, and common sense. The water is tapped from the river Blythe, in the parish of Coleshill. The map produced shows that Salmon's land has double the extent of frontage to the river Blythe that Mr. Dugdale's land has.

Mr. *T. F. Hedley*, examined by Mr. YOUNG, said he was a surveyor and valuer, and was in business at Sunderland with his son, and in Birmingham with Mason, Hedley, and Mason. He had had 20 years experience in valuing large works for assessment and other purposes, and was the valuer appointed by the County Rate Committees for Durham, Northumberland, Brecknock, and other places, and for several unions in Yorkshire, Derbyshire, Northamptonshire, Befordshire, &c. In all these instances he acted as valuer for the Assessment Committees, and was much more frequently employed for them than for the companies. In valuing works of this kind, where the whole apparatus was not within the area, his mode of proceeding was to estimate the value of the works as a whole, deducting from the aggregate value such portions as did not produce direct profit, and distributing the remainder, according to the gross or net receipts, as the case might be, between those parishes in which the direct profits were earned. In parishes where the works earned nothing, he estimated them upon the structural value of the buildings and fixed machinery, taking the gross at 5 per cent., and from that he deducted one-fifth or one-sixth, according to the scale of reduction in force in that particular district. In this case he understood the deduction was one-fifth, and that gave 4 per cent. as the rateable value. He had taken 5 per cent. as the rateable value of manufactories, but not of the gas-works, water-works, or railway-stations. Mr. Castle had valued Mr. Dugdale's land at £800 per acre, and Mr. Salmon's at £135 per acre. He could not distinguish between the value of Mr. Dugdale's land and Mr. Salmon's land as Mr. Castle had done. He estimated the whole of the 30 acres at a rental of £8 per acre, and thought it would be worth that for the purpose of the water-works concern. He could make no distinction between the value of the land within the area of the works purchased from Mr. Dugdale and that purchased from Mr. Salmon. They had both equal frontages to the Blythe, and if there was any difference in that respect, the balance was slightly in favour of Mr. Salmon's land. If this land had not been purchased, but rented, it would have been worth £8 per acre, and if the water-works company had not gone there it would have been a long time before the land would have been let at £8. Taking that at 25 years purchase, it was equivalent to £200 per acre. He and Mr. Castle examined the books on Thursday, and found the cost of the works to be £71,482 17s. 5d. In that were included the cost of the two unused filter-beds, and the mains laid since the rate was made. Deducting those two items, the real cost would be £64,131 17s. 5d. He agreed with Mr. Castle that those two items ought to be deducted. His opinion was that a further sum of 10 per cent. ought to be deducted from that for rating purposes. It was quite usual to make such a deduction, even in the case of new works, in consideration of unforeseen and accidental expenditure which might have taken place in constructing the works. It was the custom of his friends in the profession always to make such a deduction. He was well acquainted with the iron trade, and the difference between prices in 1871 and 1875 was in favour of the latter period. There was no profit made now out of the production of

iron. In the former period the iron trade was in a most inflated condition, and that would be a reason why something should be written off the outlay upon these works. In his opinion, if the Birmingham Corporation had to construct these works now, they could do it at a cheaper rate. His estimate was that £3132 should be the gross, and £2555 the rateable value. Those he considered to be fair and liberal figures. The corporation of Birmingham ought not to be assessed for the water taken from the rivers Cole and Blythe. He had never added the value of water to the land. Had always understood that the right to take water from a running stream was a mere easement, and therefore it could not be rateable. In this case the water was taken from another parish, which was another reason why it could not be rated in Shustoke parish, and if there was any beneficial occupation it arose there. In his calculation he had valued the land occupied by the filter-beds, although he had excluded the cost of those beds.

Mr. DUGDALE said he thought the witness was quite right in excluding the cost of these two unused filter-beds, for no tenant taking to these works would pay anything for filter-beds which could not be used for the next three or four years.

Witness said it would not be in accordance with the principles laid down in the West Middlesex case to do so.

Cross-examined by Mr. DUGDALE, witness said the value of the land might fluctuate. The object of a valuation theoretically was to ascertain what a tenant from year to year would give for the works, but in point of fact no one would take water-works. He did not think that the fact of a tenant paying 5, 6, or 7 per cent. upon the cost would at all supersede a fair valuation. He knew a case in which a tenant had been paying 8½ per cent. upon the mere structural cost, and in that case he reduced the valuation because he thought the tenant was paying an exorbitant sum. As corporations and large companies could borrow money at less than 4 per cent., a tenant could not be expected to pay more, as it would be cheaper to borrow the money and build for himself. He had valued the reservoir as capable of holding water, and not as holding water. He did not think the time when these contracts were made was more favourable than the present moment, as such works could be erected equally cheap now. He did not know that it was usual to put 5 per cent. down as engineer's commission. That was the usual commission for an architect.

Mr. *John Chesshire*, examined by Mr. YOUNG, said he was a surveyor, and partner in the firm of Chesshire and Gibson, Waterloo Street, Birmingham. He had had 40 years experience in valuations of this character. He was perfectly familiar with the water-works at Shustoke. His valuation was as follows:—Two engines of 225-horse nominal power, with boilers and self-acting stokers, engine-house, wells, chimney-stack, pumping machinery, &c., at £4 per horse power, £1800; reservoir, occupying nearly 10 acres of land, and constructed to contain 30 million gallons, £350; five small filter-beds and two large ones, occupying, including the embankments and supports, about seven acres of land, at £50 per acre, £350; 1467 yards of 36-inch pipe, and pipe-way under land, at 3s., £220; 900 yards of 48-inch ditto, at 4s., £180. Add for surplus land, brickwork, valves, railway siding, and underground work, say net £100; total, £3000. From this he made the following deductions:—20 per cent. on engines, pumps, &c., £360; 10 per cent. on reservoir, £35; 20 per cent. on filter-beds, £70; and 10 per cent. on mains, £40; altogether £505, say £500. The gross rental he took as £3000; rateable value, £2500. In making this estimate he did not take for his guide the cost of the work, but he took all the circumstances (including the cost) into consideration, and fixed the annual value accordingly. The filter-beds were a source of expense rather than profit to the corporation, as the water had to be lifted out of the river into the beds, and did not run into them by gravitation, as it might have done under more favourable circumstances. Therefore the cost of them in that case ought not to be taken.

Cross-examined by Mr. DUGDALE, witness said he valued the reservoir as land capable of containing water, but he did not value the water itself. He was a director of the water-works company up to the time that it was dissolved. The company advertised for contracts for these works, and employed the best men in the country. He had no doubt but that if these works had to be constructed now they could be done at much the same cost. The engine-house and the chimney were erected in a very expensive manner, in order to satisfy Sir Charles Adderley; but for the purposes of the company they were no better than if they had been put up at the ordinary cost. The company charged the corporation 6d. per 1000 gallons for the water supplied to them. That was the worst-paying part of their concern, but it was a duty imposed upon them under the Sanitary Act.

Mr. DUGDALE: I suppose you will admit that it was absolutely necessary for the company to go to Parliament to take the water from the Blythe?

Witness: We have always looked ahead, because, with a large population like Birmingham, which is nearly 400,000, if the people from any cause were without water, it would be something very serious. Before we gave up the works the corporation were pressing the company to abandon the supply from the Tame. With regard to the wells in the borough, I admit that the corporation did not show their desire to close them when the works were in possession of the company, so much as they have done since the works have been in their own hands.

[It was announced that Alderman Avery, the chairman of the Water-Works Committee, was in Court, if the respondents desired to ask any questions of him, but it was not proposed by the appellants to call him.]

Mr. YOUNG: In your judgment, as having an intimate knowledge of all the circumstances, supposing all the profits of the various parishes were allocated among them, and the expenses averaged, with the exception of Birmingham, is there any single parish which would yield a per centage of 4 per cent.?

Mr. DUGDALE objected to the question as, having had no notice on the subject, he was unable to test any facts that might be stated.

Mr. YOUNG briefly summed up the case for the appellants. He said the simple question was as to the principle upon which the water-works at Shustoke, where no earnings were obtained, should be rated. That principle, he maintained, had been clearly laid down in the case of *The West Middlesex Water-Works Company v. Hampton* — viz., that they must be rated as ordinary buildings contributing only indirectly to earnings in another parish.

Mr. DUGDALE, in reply, submitted that the contention of the appellants, that the per centage upon which the valuation was based was a fixed per centage in relation to the question of cost, was erroneous, for the cost was only an element in the process of calculation by which the fair annual value of the works was determined. The per centage was not fixed, but varied according to circumstances, and according to what a tenant might be disposed to give for the property. He took it to be clear law that there was to be no hard and fast line, but that the value should be determined from year to year, and from time to time, according to the circumstances of the case. And, further, there were no fixed principles by which the Court could be guided in this matter. In that view he was fortified by the remarks by Justice Wightman, who delivered the judgment of the Court in the West Middlesex case, upon which Mr. Young relied. The cost of the works was the starting-point in the calculations made by the surveyors, but it was not necessarily the basis of the assessment. He submitted that the fact that persons had been found willing to take the works at an increased value was evidence of the liability of the works to be rated at that increased value. In arguing this question, he was not bound by anything which the Assessment Committee had done, because they had made out their assessment without having had access to the books, and the case now came before the Court *de novo*. He contended that the profits made in other parishes were to be taken into consideration in assessing the value of the works in Shustoke parish, and in support of that he submitted the ruling in *The Queen v. Mile End Old Town Vestry* (10 Q.B. Reports, 208), where it was held that "the parts indirectly conducing to produce profit are to be rated as mere land, &c., with some additional value from their capacity of being applied to such purposes as those of a water company." That view was upheld in the case of *The King v. The New River Company* (1 M. and S., 503), where the question before the Court was whether Amwell should rate Chadwell Mead at £5 or £300. The case stated that no profits arose in Amwell; that the land alone, without the spring, was of the value of £5; but if the advantage which the company derived from the use of the spring might by law be included in the rate upon the land, the land and the spring would together be of the annual value of £300. The judgment of the Court was for the £300. He referred also to the case of *Tallagog Mining Company v. St. Asaph's Union* (3 Q.B. Reports, 478), where allowance was made for the water. With reference to the value of the land, he submitted that the portion purchased from Mr. Salmon was merely agricultural land, which had no connexion with the Blythe, while Mr. Dugdale's land was that over which the water flowed, and the purchase also included pipes in the parish of Coleshill right up to the mouth of the river. There was, therefore, nothing extravagant in the price they had put upon it, for surely the company did not expect to get their water for nothing. If interest at the rate of 5 per cent. per anhum were computed upon the total value they had placed upon the land and water, it would amount to £585 per annum, and that distributed over the quantity of water raised and pumped into Birmingham would be at the rate of £1 4s. per million gallons. But the company sold their water at the rate of 6d. per 1000 gallons, or £25 per million gallons, which showed that it was worth their while to pay £800, or even £1000 an acre for the land. At all events, whatever they paid, it was clearly a profitable concern, for they had been able to meet all their dividends and debts, and make a profit beside. He again submitted that this land ought to be valued as land covered with water, and not as land capable of holding water, and if they did not value it in that way, it was not valued as the law said it should be. No matter whether the water flowed upon the land, or had to be pumped upon the land, it was as much impounded there as in the Amwell case, respecting which Lord Ellenborough said: "The water has a certain ascertained local value at the fountain head. If it has, it is rateable for that value, irrespective of profits which may or may not be derived elsewhere from distribution through the pipes." In asking that, in this case, the land should be rated at £800 per acre, the respondents were only asking that the assessment should be based upon four times the amount which the appellants said was its fair value. But in the Amwell case the sum of £300, fixed by the Court, was more than sixty times in excess of the value of the land.

The CHAIRMAN: But you do not take any water in Shustoke parish.

Mr. DUGDALE said the old record of a trial at Warwick Assizes, between Sir William Dugdale, the historian and antiquary, and the then vicar of Coleshill, which had been referred to, respecting the right of cutting bulrushes in the river Blythe, contained an old map which showed the Blythe to be in the parish of Shustoke.

Mr. YOUNG objected that in contradiction to this the evidence now given proved that the river was in the parish of Coleshill.

Mr. DUGDALE proceeded. He thought the ruling of the Court in the Tallagog Mining Company's case, to the effect that "the value of the land was increased by the value of the water upon it," was favourable to his view of the present case, and that his learned friend's witnesses were mistaken in valuing this land as though it was only capable of holding water. With regard to the commission for architects, &c., the learned counsel supported the view of Mr. Castle, that something should be added, because Mr. Gray, the engineer of the company, had no doubt been the means of saving them a very large sum of money, and he hoped that when the company were dissolved his services were handsomly acknowledged. Then, again, as to the materials found upon the land. Were they not elements of value? If they had not been there the cost of erecting these works would have been very much increased. Taking Mr. Castle's estimates of 10 per cent. for the latter and 5 per cent. for the former, it would bring the total cost up to £86,000, which substantially proved the rate. Under the circumstances, he asked the Court to say that this was a case in which the evidence of the surveyors, as to cost, was of no value, because there was evidence of an increase of value, and also evidence of a tenant having taken to the property at a greatly increased price. He looked upon the appeal as an attempt on the part of the people of Birmingham to obtain an undue proportion of the profits of the water-works for distribution in the town.

The Court having conferred for a few minutes,

The CHAIRMAN said: We have given this case our most careful consideration, bringing to bear upon it the best intelligence we possess. Looking at the course laid down by the Act of Parliament, and confirmed by the West Middlesex case, we have arrived at a certain conclusion. It is quite right that valuers should be appointed, in cases of this sort, on the part of the Assessment Committee, to ascertain what is the value of property of this description. But then we take the result of that valuation as it comes before us to-day in the joint valuation of two gentlemen—one appointed by each party. Those gentlemen consulted together and made the entire outlay £71,482 17s. 5d., subject to deductions on two accounts—viz., £5775 for unused filter-beds, £1575 for pipes not at present used—making together £7350 to be deducted from the gross outlay of £71,482. After making these deductions, there remains the net sum of £64,132 17s. 5d. That takes in all the plant. Then there is a question as to the value of the land. In considering this while the case was in progress, it occurred to me that the real value of the land which we ought to take is the price for which that quantity was sold when it was appropriated to these works. Mr. Dugdale obtained from the company a very high price for his land, amounting to £370 per acre. Of the 50 acres it appears they have appropriated 15. I will say 15, because it is not worth while looking at the 18 perches. We think that, taking that 15 times over, would be the proper addition to the £64,132 arrived at by the surveyors on account of Mr. Dugdale's land, and that that would naturally and fairly include all the easements and advantages which were derived to the company from the land conveyed to them by Mr. Dugdale. We think the fair and proper way of dealing with Mr. Dugdale's land is not to include the 35 acres which the water department do not use in part valuation of the money paid for it. It is totally independent. The 35 acres do not come into our consideration. There is the cost of Mr. Salmon's land, £2030, and £150 for way leave. Adding these to the increased value I have named of Mr. Dugdale's 15 acres makes a total of £7730. This sum increases the £64,132 to £71,862 as the outlay on the works at Shustoke. That gives a gross estimated value, at 5 per cent., of £3593. We propose that that figure shall stand as the gross in the valuation list, subject to the deduction for rateable value;

and if you take that at 1 per cent., which is what they adopted before, it would reduce the rateable value at £2875.

Mr. YOUNG: You direct the assessment to be amended accordingly.

The CHAIRMAN: The valuation list will be so amended.

Mr. YOUNG: I do not know what is the usual course of the Court as to costs.

The CHAIRMAN: The Court rarely grant costs, and never in a case which has been fairly and properly brought before them. In cases where they think there is no ground for increasing the assessment, the Court do sometimes order costs; but we do not say that no such probable grounds existed here. I hope that that will be satisfactory to the parish.

Miscellaneous News.

METROPOLIS WATER SUPPLY.

The Registrar-General publishes the following return of the average daily quantity of water supplied by the London Water Companies during the month of December, 1876. According to these, 110,423,339 gallons, or 501,704 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight), were supplied daily; or 208 gallons (94·5 decalitres) rather less than a *ton* by weight, to each house, and 29·3 gallons (13·3 decalitres) to each person, against 30·1 gallons during December, 1875. According to returns of the London Water Companies made to the Select Committee on East London Water Bills (Session 1867), it is estimated that, during the year 1866, about 82 per cent. of the total average daily supply of water for all purposes was for domestic use. Applying this proportion to the total quantity supplied daily in the month of December, 1876, it may be estimated that about 90,547,138 gallons were probably used for domestic purposes, or about 24·0 gallons per day for each inhabitant, against 24·7 in the corresponding month of last year.

Companies.	Number of Houses, &c., supplied in Dec., 1875.	Dec., 1876.	Aver. Daily Supply of Water in Gallons* during Dec., 1875.	Dec., 1876.
Total supply	521,566	531,445	111,420,340	110,423,339
From Thames	245,577	250,648	56,423,469	56,032,761
„ Lea and other Sources	275,989	280,797	54,996,871	54,390,578
THAMES.				
Chelsea	28,600	28,737	6,744,600	6,881,600
West Middlesex	47,400	48,680	9,131,684	9,533,505
Southwark and Vauxhall	80,300	80,705	18,000,000	17,820,000
Grand Junction	36,036	37,035	10,186,185	10,284,856
Lambeth	53,241	55,471	12,361,000	11,512,800
LEA AND OTHER SOURCES.				
New River	123,915	125,011	26,160,000	24,132,000
East London	107,851	110,354	22,515,000	23,849,800
Kent	44,223	45,432	6,321,871	6,408,778

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for December, 1876, as compared with that for the corresponding month of 1875, shows an increase of 9879 houses, and a decrease of 997,001 gallons of water supplied daily.

Dr. Frankland, F.R.S., reports, as the result of his analysis of the waters supplied to the Metropolis during December, that, taking unity to represent the amount of organic impurity (on this occasion) in a given volume of the Kent Company's water, the proportional amount in an equal quantity of water supplied by each of the other metropolitan companies was—New River 3·1, East London 4·0, Lambeth 6·2, West Middlesex 6·7, Chelsea 7·0, Grand Junction 7·6, and Southwark 9·5. The Thames was in high flood during the greater part of December, and the water delivered by the five companies deriving their supply from this source was "utterly unfit for domestic use," in consequence of its large proportion of "polluted organic matter." The West Middlesex alone of these five companies delivered efficiently filtered water, whereas the four other waters were more or less turbid when drawn from the mains; all the Thames waters were, however, "loaded with organic impurities of the most disgusting origin." An analysis of a sample of the Grand Junction Company's water, after filtration through spongy iron, showed that nine-tenths of the organic matter, and more than one half of the hardness, had been removed from the water. The water supplied by the New River and East London Companies, principally from the River Lea, showed less pollution than the Thames water; the proportion of organic matter in the New River Company's water was, however, nearly three times greater than in November. The Kent Company's deep well water, on the other hand, was entirely unaffected by the heavy rains, and was even purer in December than in the preceding months.

RICHMOND WATER SUPPLY.

At a Meeting of the Select Vestry of Richmond on Tuesday, Jan. 9, the following report of the Water Supply Committee was adopted:—

"The committee, acting in pursuance of the resolution passed at the vestry meeting held on Dec. 19, 1876, which directed that 'the letter from Mr. Rumble, chief engineer of the Southwark and Vauxhall Water Company, dated the 15th of December last, should be referred to them, with instructions to consult the engineers of the new works thereon, and to take such steps in the matter as they may think fit,' beg to report as follows:—The committee met on the 20th of December last, and frequently since—namely, on the 21st, 23rd, 27th, 28th, and 29th of December, and on the 1st, 2nd, 3rd, 4th, 5th, 6th, and 8th days of the present month. From information obtained through the engineers the committee made application to Her Majesty's Office of Works for a temporary supply of water from the reservoir in Richmond Park belonging to that department, used for the supply of water to Kew Gardens. They also instructed the vestry clerk to lay Mr. Rumble's letter before counsel, and take an opinion on the rights of the inhabitants as regards the threatened cutting off by the Southwark and Vauxhall Company of the water supply to the town. Finding that delay was likely to take place in obtaining an answer from Her Majesty's Office of Works, owing to the absence from town of the First Commissioner, the committee directed the attention of the engineers to the existing artesian wells in the parish, with a view of ascertaining the capabilities of the same to afford a supply of water to the inhabitants. On the 27th ult. the clerk laid before the committee the opinion of counsel, which was to the effect that the Southwark and Vauxhall Water Company could discontinue the supply of water to the town as they proposed to do, and that the Court would not grant an injunction to restrain them from so doing, because the supply by that company to Richmond was beyond their parliamentary limits, and, therefore, *ultra vires*, and for the same reason he could not advise the vestry to enter into any arrangement with the Southwark Company for a supply of water to the town, as, in the event of any breach by the company of such arrangement, the vestry, if attempting to enforce it, would only involve the parish in somewhat uncertain litigation. The committee having received a report from the engineers that they had obtained information from the most reliable sources that the artesian well sunk some years since by the late Richmond Water-Works Company was capable of affording, with proper engine power, an ample supply, equal to at least 20 gallons per head per day for the inhabitants, they opened negotiations through their chairman and clerk with the lady whose newly erected residence is over this artesian well, and such negotiations having resulted in your committee obtaining possession of the premises, they at once gave orders for the erection of the necessary engines, &c., which works are now all but completed. The committee also carefully considered the rate of charges which it would be desirable to make to the consumers, having due regard to the interests of the parishioners, as well as making ample provision for every possible expense likely to be incurred in affording the supply, and they confidently recommend the adoption by the vestry of the following rates, viz.:—1. Private houses and shops, 6d. in the pound per annum on the rateable value, with no extra charge for baths, &c. 2. Breweries and the like to be supplied by meter, at a rate not exceeding 6d. per 1000 gallons, or by special agreement with the vestry. 3. The water-rate to be collected quarterly, together with the poor and highway rate. 4. The Vestry to make the necessary change from the Southwark Company's main without expense to the consumer, and with as little delay as possible. Acting under the advice of their counsel, the committee issued a circular to the inhabitants, stating the position of the matter and the proposed charges; and the result has been most gratifying to the committee, inasmuch as they have received nearly 2000 individual applications for a supply from the vestry, many of such having reference to three and four different assessments, and in some cases even more. The committee being fully alive to the great importance of economy in the supply, advertised for an inspector of fittings and turncock, in answer to which they received ten applications, but eight of the applicants appeared to be wholly unacquainted with the duties, and of the two others they selected George Stribling, a resident in this town, who has had many years experience of the work. The committee also issued invitations for tenders for the making of the connexions between the parish mains and the houses of the residents, and were pleased to find that eleven local tradesmen came forward and placed their services at the disposal of the parish, thereby enabling the committee to retain this part of the work in the hands of their fellow-townsmen. The committee have also to report that the laying of the mains, with a few exceptions, will be completed before the end of the week. In presenting this report, the committee recommend the vestry to continue to watch the works through a committee as heretofore, such committee being empowered to take such steps in the matter as they may from time to time think fit."

BOLTON CORPORATION GAS-WORKS.

The Abstract of the Annual Accounts for the Borough of Bolton has just been issued by Mr. G. SWAINSON, the borough treasurer, from which we make the following extracts relating to the affairs of the gas undertaking:—

GAS-WORKS FUND ACCOUNT, FOR THE YEAR ENDING JUNE 30, 1876.

Dr.—Revenue Account.

To Gas and meter rental—			
358,171,000 cubic feet of gas supplied to consumers during the year	£71,886 15 0		
One year's rent of meters	761 0 11		
	£72,647 15 11		
Less discounts allowed	£3,942 6 0		
Ditto, bad debts	269 0 2		
	4,211 6 2		
		£68,436 9 9	
Residual products—			
Coke sold	£4,066 7 10		
Tar ditto	3,528 18 0		
Spent lime sold	137 15 2		
Ammoniacal salts and liquor sold	2,793 10 1		
Retort carbon and sundries sold	30 15 6		
		10,547 6 7	
Fitting trade—			
Total of fittings and meters sold	£7,201 3 6		
Less cost of wages and materials, &c.	5,691 2 9		
Profit for the year		1,510 0 9	
Chief rents, &c.		195 2 7	
Miscellaneous receipts—Transfer fees		7 2 6	
Interest account—Bank interest allowed		148 6 8	
		£80,844 8 10	

Cr.—Revenue Account.

By Gas manufacture—			
Carbonization—			
Cannel and coal consumed	£35,071 10 9		
Stokers wages	5,279 12 1		
		£40,351 2 10	
Purification—			
Lime	£768 15 8		
Wages of workmen	808 2 8		
		1,576 18 4	
Retorts, materials, and labour—			
Wages of workmen	£485 15 9		
Gas-retorts, fire-bricks, tiles, clay, &c.	1,208 17 11		
		1,694 13 8	
Repairs of works and services, &c.		3,574 8 4	
General expenses		295 1 6	
Chief rents, &c.		152 2 5	
Salaries		1,959 0 11	
Meter inspection		708 4 0	
Rates and taxes		1,205 10 9	
Office and miscellaneous expenses		504 8 5	
Law charges		360 16 11	
Interest and annuities		17,126 0 7	
Sinking-fund account—			
Amount transferred towards redemption of annuities and debt, being 1¼ per cent. on mortgage debt of £54,704	£683 16 0		
And 1-75th part of capitalized value of annuities at 25 years purchase	4,820 1 6		
		5,503 17 6	
District-rate account		3,000 0 0	
Renewal-fund account—Amount set apart to provide for renewal of works and plant, &c., being balance of profit for year 1875–6		2,832 2 3	
		£80,844 8 10	

Dr.—Renewal-Fund Account.

To Balance, June 30, 1875	£8,564 9 10
Revenue account—Amount transferred, being balance of profit, 1875–6	2,832 2 8
	£11,396 12 6

Cr.—Renewal-Fund Account.

By Expenditure for the year	£6,328 10 2
Balance, June 30, 1876	5,068 2 4
	£11,396 12 6

Dr.—Deposit-Fund Account.

To Balance, June 30, 1875		£4,223 1 0
Amount received from sundry depositors, as security for payment of gas-rent		1,899 0 0
		£6,122 1 0

Cr.—Deposit-Fund Account.

By Deposits repaid—Amount returned to sundry depositors during the year		£1,293 15 0
Balance, June 30, 1876		4,828 6 0
		£6,122 1 0

Dr.—Sinking-Fund Account.

To Balance, June 30, 1875		£696 0 0
Revenue account—		
Amount transferred towards redemption of annuities and debt, being 1¼ per cent. on mortgage debt of £54,704.	£683 16 0	
And 1-75th part of capitalized value of annuities at 25 years purchase	4,820 1 6	
	5,503 17 6	
	£6,199 17 6	

Cr.—Sinking-Fund Account.

By Balance, June 30, 1876	£6,199 17 6
	£6,199 17 6

Dr.—Capital Account.

To Balance, June 30, 1875	£8,066 8 10
Loans received	15,300 0 0
Extension of mains and services—Amount received for old metal sold	82 6 1
	£23,448 14 11

Cr.—Capital Account.

By Loans repaid	£1,018 0 0
Extension of works	4,743 6 10
Ditto of mains and services	4,458 4 8
New meters	1,911 8 9
Balance, June 30, 1876, being the difference between the floating assets and liabilities, as per stock account	11,317 14 8
	£23,448 14 11

ASSETS.

To Works and plant—		
As per last abstract	£253,603 1 3	
Additions during the past year	11,030 14 2	
		£264,633 15 5
Floating assets—		
Amount owing by sundry debtors, June 30, 1876	£14,833 1 9	
Stock of cannel and coal " "	809 0 0	
Ditto of chemicals " "	360 0 0	
Ditto of meters and fittings " "	4,924 1 0	
Bank of Bolton, balance in hand " "	13,522 10 0	
		34,489 12 9
		£299,073 8 2

LIABILITIES.

By Old shareholders capital, converted into annuities amounting to £14,460 per annum		£205,947 10 1
Mortgages on credit of borough-fund		70,004 0 0
Floating liabilities—		
Renewal-fund account	£5,068 2 4	
Deposit-fund ditto	4,828 6 0	
Sinking-fund ditto	6,199 17 6	
Amount owing to sundry creditors	7,025 12 3	
	23,121 18 1	
	£299,073 8 2	

Mr. HARRISON VEEVERS, the engineer and manager of the corporation gas-works, has made a report to the Gas Committee upon the business of his department for the past month, which contains some interesting information. He says :—

The following tables give information on the manufacture of gas, &c., in the months of December, 1875, and 1876 :—

	Dec., 1875.		Dec., 1876.
Gas made, in feet	64,763,000	..	68,078,000
Increase per cent.		..	5·12
Cannel used—tons	2,446	..	3,093
Coal used—tons	3,667	..	3,090
Cannel and coal—total	6,113	..	6,183
Make per ton, in feet	10,554	..	11,100
Retorts in use, Nov. 30	440	..	440
Retorts in use, Dec. 31	440	..	468
Stokers employed, Nov. 30	92	..	92
Stokers employed, Dec. 31	92	..	97
Artizans and Labourers	134	..	180
Clerks, meter inspectors, &c.	32	..	32

The continued use of a greater proportion of cannel referred to in the last report, has had the effect of improving the illuminating power, which has been better during this month than in either of the two preceding ones. Having the assistance of 28 of the retorts in the new stack at Lum Street, the manufacture of gas has been conducted much more satisfactorily than during the corresponding period of last year. With the exception of a stoppage of the centre-valve of one set of the purifiers at Lum Street for a few hours on the 27th, which caused a cessation of work of about 100 retorts, no irregularity has occurred.

The amounts of cash received are as follows :—

	Dec., 1875.		Dec., 1876.
Gas	£802 8 4	..	£1545 9 8
Meter-rents	22 16 4	..	42 9 4
Meters and fittings	639 7 3	..	214 13 9
Washing liquor	10 14 0	..	4 8 6
Ammoniacal salts	415 0 2	..	962 6 8
Tar	359 16 11	..	2 1 8
Coke	457 9 8	..	273 15 6
Spent lime	20 19 1	..	21 10 11
Deposits	256 5 0	..	271 5 0
Rents	17 11 9	..	9 11 3
Sundries	1 8 3	..	4 9 2
Transfer fees	0 2 6	..	0 0 0
	£2983 19 3		£3352 1 5

The facts that in this month there were 412 cases of repairs, &c., attended, as against 330 in December last year; and 230 new meters fixed, against 154 a year ago, indicate a healthy activity in the fitting department. Of the 230 meters fixed 76 were renewals, and of the 154, 67 were to replace old ones. The principal work has been fitting the mills of Mr. Briggs, and of Mr. Constantine, the St. Bartholomew's Schools, and the new tramp ward.

In addition to the remedying of escapes and other defects in mains and services, the main-layers have done the following work :—

9-inch mains, cast iron	90 yards.
4-inch " "	171 "
3-inch " "	3 "
2-inch " "	1050 "

There were also laid the following services :—

¾-inch lead	61
2-inch "	8
1-inch "	10
2-inch cast iron	2
	81

Being three more than in December, 1875.

During the years and half years ending Dec. 31, 1875 and 1876, the following results have been attained, which are satisfactory as indicating a progress in the manufacturing department as great as can be expected.

	Years ending Dec. 31, 1875.		Dec. 31, 1876.
Cannel and coal used—tons	38,248	..	38,947
Gas made, in feet	401,209,000	..	412,088,000
An increase of	—	..	2·71
Make per ton, in feet	10,489	..	10,580
	Half years ending Dec. 31, 1875.		Dec. 31, 1876.
Cannel and coal used—tons	19,942	..	20,267
Gas made, in feet	212,509,000	..	220,175,000
An increase of	—	..	3·6
Make per ton, in feet	10,656	..	10,863

The last item is instructive, as it shows an increased average yield per ton on all the cannel and coal used during the half year of 202 feet, or a total of 4,094,000 feet. This may be accounted for by the facts that the retorts are in better order, and the cannel and coal of better quality.

During the past year the average price of sulphate of ammonia has been £17 10s. per ton, an increase on the price in the previous year of £1.

With reference to the extensions at Lum Street, it may be remarked that, with the exception of the delay of the contractors for the roof, the work has progressed as satisfactorily as the shortness of daylight and the unfavourable weather would permit.

The chimney and all brickwork are finished. The purifying-house is still waiting for the roof, as are also the smaller buildings. The condensers, scrubbers, one set of purifiers, and the connecting-mains, are nearly completed, and the purifying-house ground-floor is ready for paving.

The report concludes by stating that at the present time there are 88 men engaged on the extensions.

BILSTON GAS COMPANY.

The Thirty-first Annual General Meeting of the Shareholders of this Company was held at the Town Hall, Bilston, on Monday, Jan. 8—WILLIAM HATTON, Esq., J.P., in the chair.

The CLERK (Mr. J. S. Reeves) having read the notice convening the meeting, the following report and statement of accounts were presented :—

The directors herewith present to the shareholders their thirty-first annual report, together with statement of accounts.

The trade account shows a profit of £3933 1s. 10d. which, with £449 2s. 1d. brought from last year's account, makes a total of £4382 3s. 11d. at the disposal of the directors. This sum they propose to appropriate as follows :—

Half year's dividend of 4s. per share paid Aug. 1, 1876	£1200 0 0
Half year's dividend of 4s. per share payable Feb. 1, 1877	1200 0 0
Reserve-fund account	200 0 0
Carry forward to next year's account	1782 3 11
	£4382 3 11

The various improvements which, during the past three years, have been made in the distributing plant are realizing the expectations of your directors, and have resulted in a large increase in the quantity of gas sold, giving to the consumers a more satisfactory supply, and to the company a substantial increase of profits.

These favourable circumstances, coupled with lower rates paid for coal, have enabled your directors to announce another reduction in the price of gas, varying in amount from 3d. to 6d. per 1000 cubic feet.

The erection of the new works was commenced in the spring of last year, and considerable progress has been made. The 100-feet gasholder, retort-house, coal-stores, and purifiers are approaching completion, but will not be available for use this winter.

The amounts expended in these erections are set forth in the annexed accounts.

To meet the cost of the new works, the directors have exercised the powers given them by the extraordinary meetings of shareholders, and have raised £5000 by the issue of debentures bearing interest at the rate of 6 per cent. per annum. They also have issued 1000 new shares of £5 each since the close of the financial year.

The directors who retire by rotation are Messrs. J. T. Field, T. Holcroft, and E. Hickman; Messrs. Holcroft and Hickman offer themselves for re-election.

One of the auditors, Mr. T. H. Hickman, having resigned during the year, Mr. Charles Hatton was appointed in his place. Mr. E. Ellis and Mr. C. Hatton retire, and are eligible for re-election.

The capital, works expenditure, and reserve-fund accounts are rendered herewith.

Dr. Trade Account, from Oct. 1, 1875, to Sept. 30, 1876. Cr.

Stock	£846 10 0	Sales	£5,862 18 7
Purchases	3,126 19 9	Do.	5,530 2 10
Do.	2,678 12 11	Do.	2,614 14 6
Do.	1,863 16 3	Do.	2,873 12 0
Do.	1,625 10 9	Stock	424 3 9
Wages	2,498 19 10	Interest	36 19 3
Allowances and bad debts	204 19 7		
Deterioration of works for one year	564 0 0		
Balance (profit)	3,933 1 10		
	£17,342 10 11		£17,342 10 11

Capital Account—Cr.

6000 shares, at £5 per share	£30,000 0 0
100 debentures, at £50 each	5,000 0 0
	£35,000 0 0

Works Account—Dr.

Works, as per published statement, 1875	£28,383 13 6
Amount expended in purchase of land at Millfields, as stated in 1875 account	2,090 0 0
Amount expended on works, extension and enlargement of mains, in year 1876	877 18 10
Amount expended in the erection of new works at Millfields	6,494 15 1
	£37,846 7 5
Less deterioration of works for one year	564 0 0
	£37,282 7 5

Reserve-Fund Account—Cr.

Balance, as per statement published Sept. 30, 1875	£2,590 6 6
Amount brought from profit account, Sept. 30, 1876	200 0 0
	£2,790 6 6

The CHAIRMAN moved the adoption of the report, and said he thought the meeting would concur with him that the report was a very satisfactory

one. They were not only paying the usual dividend, but they had a larger balance than usual to carry forward. The alterations of the mains referred to in the report, though costly in the first instance, were repaying themselves rapidly. The increased quantity of gas sold during the past year had been upwards of 5 million cubic feet. With their increased prosperity the directors had not been unmindful of the interests of the consumers; but when the dividend was assured, they had, unsolicited, announced a reduction in the price of gas. The building of the new works was progressing, and they would be in operation next winter.

The report having been adopted, a resolution authorizing the payment of a dividend of 8 per cent. for the year was approved. Two of the retiring directors were re-elected, and Mr. Thos. Bradley elected in place of the third. The directors were thanked for their services, and, after some discussion, it was unanimously resolved that their fees in future be £200 per year.

The clerk and manager (Mr. J. S. Reeves) was complimented on the manner in which he had discharged his duties, and a vote of thanks to the chairman brought the proceedings to a close.

CARLISLE CORPORATION GAS AND WATER WORKS.

The Abstract of the Gas and Water Accounts of the Corporation of Carlisle, for the year ending June 30, 1876, has just been published. The following are the statements of capital and revenue in each department:—

GAS.

Dr. — *Capital Account.* — *Cr.*

Total expenditure on permanent works to June 30, 1875 (less annual depreciation)		£34,331	5	0	Balance, being net value of works at this date	£35,530	3	6
Less one year's depreciation, at 3 per cent.		1,029	18	9				
		£33,301	6	3				
Expended in extensions during the year—								
Lamps and fittings		72	16	5				
Mains		2,067	7	11				
Service-pipes		88	12	11				
		£35,530	3	6		£35,530	3	6

Profit and Loss Account.

Stock account, June 30, 1875	£4,253	9	10	Gas sold in year	£15,468	6	4
Ditto of coal, ditto	326	5	0	Coke	2,741	6	8
Cannel, coal, and cartage	9,547	0	3	Tar, ammoniacal liquor, &c.	1,924	0	9
Purifying material	331	4	1	Mortar	448	15	7
Salaries—				Meters, fittings, castings, old metal, &c.	7,646	6	3
Manager	300	0	0	Interest from bank	47	11	8
Accountant, clerks, and collectors	360	5	6	Ditto from reserve-fund	300	7	0
Auditors	44	2	0	Stock account, June 30, 1876	5,361	15	3
Wages	4,483	14	11	Ditto of coal, ditto	76	16	0
Meters, fittings, and castings	7,801	18	9				
Retorts and fire goods	302	0	3				
Rents, rates, and taxes	289	13	11				
Printing, stationery, postage, &c.	171	9	1				
Tradesmen's accounts	852	2	8				
Incidentals, &c.	52	1	1				
Bad debts	38	2	9				
Interest on deposits	31	0	4				
Ditto mortgage bond	396	5	0				
Legal expenses	33	5	6				
Balance, being profit for the year	5,401	4	7				
	£35,015	5	6		£35,015	5	6

Appropriation of Profits.

Corporation (annual payment)	£200	0	0	Gross profits	£5,401	4	7
Amount expended on extensions	2,228	17	3				
Set apart for interest on deposits	150	0	0				
Mortgages paid off	989	0	0				
Balance	1,833	7	4				
	£5,401	4	7		£5,401	4	7

WATER.

Dr. — *Capital Account.* — *Cr.*

Total expenditure on works to June 30, 1875 (less annual depreciation)		£43,600	5	11	Balance, being net cost of works to this date (less annual deduction for depreciation)	£43,154	11	5
Less one year's depreciation, at 3 per cent.		1,308	0	2				
		£42,292	5	9				
Extensions during year—								
Mains		741	4	5				
Service-pipes		121	1	3				
		£43,154	11	5		£43,154	11	5

Profit and Loss Account.

Stock account, June 30, 1875	£619	9	11	Water sold in year	£5,414	8	6
Coal and cartage	341	17	3	Pipes, castings, service-pipes, &c.	1,051	16	11
Salaries—				Interest from bank	32	1	9
Manager	50	0	0	Stock account, June 30, 1876	958	11	7
Accountant, clerks, and collectors	96	5	0				
Auditors	18	18	0				
Wages	710	7	7				
Pipes, castings, sluices, &c.	1,114	9	9				
Rents, rates, and taxes	124	3	4				
Printing, stationery, postage, &c.	36	11	6				
Incidentals, &c.	1	3	4				
Bad debts	1	1	11				
Tradesmen's accounts	279	13	11				
Legal expenses	53	9	3				
Interest on mortgage bonds	1,636	11	2				
Balance, being profit for the year	2,372	16	10				
	£7,456	18	9		£7,456	18	9

PROPOSED PURCHASE OF THE WARRINGTON GAS-WORKS.—The *Warrington Guardian* states that an informal meeting of the council was held on Tuesday, to confer on the feasibility of a proposal to submit the vexed question of the gas purchase practically to the arbitration of some engineer of eminence. The following resolution was adopted:—"The mayor having submitted to the council a proposition for the engagement of Mr. Hawksley to report further on the terms of purchase of the gas-works, it was resolved—That, on the Chairman of the Opposition Committee undertaking on their behalf to withdraw from further opposition to the purchase of the gas-works if Mr. Hawksley should advise that the purchase is a good one, the council assents to the employment of Mr. Hawksley to advise on the terms, on the distinct understanding that no instructions be laid before him beyond the simple terms of the purchase, and such other information as he himself may require."

LEEDS CORPORATION GAS SUPPLY.

At the Annual Meeting of the Leeds Chamber of Commerce on Wednesday, the 10th inst.—the PRESIDENT (Alderman Barran, M.P.) in the chair,

The SECRETARY read the 26th annual report of the council, which contained the following paragraph referring to the quality of the gas supplied to the town:—"The council are sorry to have observed that the quality of the gas now is much inferior to that formerly supplied by the companies. Instances have been known of work occasionally having to be stopped from sheer want of light, and much inconvenience is daily felt by consumers."

The CHAIRMAN moved the adoption of the report.

Mr. WHEELHOUSE, M.P., in seconding the motion, said, as regarded the question of the supply of gas, he could not understand why, since its manufacture had got into the hands of the corporation, it should have been neither what it ought to be, nor yet equal to what it used to be. Personally, he might state that years ago his bill for the consumption of gas was only one-half what it now was, and yet he did not consume by any means so much as formerly. He had not put one single additional light into his house for years. He hoped that the question would be inquired into, an opinion in which he knew he was largely supported by his fellow-citizens.

Mr. TENNANT, M.P., said he was not aware what provisions were made when the gas companies transferred their works to the corporation, but surely there were some restrictions introduced, under which action might be taken. If there were any such provisions, he thought they ought to take advantage of them, and endeavour to get a remedy—securing a better supply, and also enforcing that reduction for large consumers which was certainly an understanding, if not absolutely binding between the companies and the large consumers. He hoped that some representation would be made to the Town Council, and, if need be, action taken, both by the Chamber of Commerce and on behalf of the inhabitants.

The report was adopted.

FATAL GAS EXPLOSION AT PIMLICO.

On Sunday evening, the 31st of December last, an alarming explosion of gas took place in the cellarage of a house, No. 48, Stanley Street, Pimlico, by which considerable damage was done to the premises, and a woman and child residing there were fearfully burned. These unfortunate people were immediately conveyed to St. George's Hospital, where, after lingering until Saturday, the 6th inst., the woman died. The accident, as will be seen from the evidence given at the inquest, is almost certainly attributable to the use of the steam-roller, by which the main running beneath the roadway was fractured. The ground in this locality is very loose, the whole district not many years ago having been a marsh, and the late excessive rains have contributed to increase the softness of the soil.

On Thursday evening last, Mr. Bedford, the coroner for Westminster, held an inquest, at St. George's Hospital, on the body of Mrs. Frances Pitcher, whose death took place under the circumstances just named.

The jury having viewed the body, the following evidence was given:—

Mary Prescott said: I am a lodging-house keeper, residing at 166, Warwick Street. The deceased was my sister. She was the widow of Robert Pitcher, formerly a solicitor's clerk. Her age was 35. She was in a nurse's situation at 48, Stanley Street, at the time of the explosion.

Mrs. *Ellen Henney:* I am a widow, residing at 48, Stanley Street. I have lived there 12 months. The gas-fittings in the house were new when I went in, and nothing in the way of repairs has been done to them since. I have never perceived the smell of gas in any part of the premises. On Sunday, the last day of December, we were sitting at tea at about a quarter to seven, and Mrs. Pitcher's little girl, who was there on a visit, went to the larder to put away the bread and butter, and her mother took a little spirit-lamp to show her a light. The larder is close to the coal-cellar door, but inside the passage, the coal-cellar itself being in the area. I was in the kitchen at the time, and heard an explosion, and saw a flash of light. I was not thrown down by the concussion, and I ran upstairs and out into the street, calling for assistance. Mrs. Pitcher was brought up by the police, and taken to the hospital. I did not go down stairs afterwards. The gas-meter was close to the cellar door. I had never turned off the meter myself, and I had never perceived the smell of gas there. I have smelt it very slightly in the coal-cellar during the last six months. Mrs. Pitcher has asked the gas man several times, and I asked him once, whether there was any danger—that is, the man that came to see the meter. I was in the area at the time, and called his attention to a smell being in the cellar. He went into the cellar, and then said there was no danger. I sent to the Board of Works on the Saturday before the explosion, thinking it was the drainage. After the explosion, six or seven men came to repair the damage. There was no work going on with the gas-pipes in the cellar before then.

By Mr. HUMPHREY (who attended to watch the proceedings for the Chartered Gas Company): I cannot exactly say, but I think it was nearly six months ago since I spoke to the man about the smell in the cellar. He told me there was no danger, and that it had nothing to do with my meter in the house. I think it was the sewer that we smelt on the Saturday after the steam-roller had been over it. The roadway of Stanley Street has been under repair lately. It was being repaired at the time of the explosion, and the steam-roller was used on the Saturday exactly opposite my house. The explosion took place on the following Sunday evening. I saw Mrs. Pitcher lying in the passage of the basement after the explosion, but I did not see her little girl. She was injured at the time, but is still alive. Mrs. Pitcher had been living with me about 10 months. She came first of all to nurse me, and has since been looking out for a situation. She took care of the house for me meanwhile, as I had been away two months, and I paid her for doing so.

By Mr. CASS (who appeared for the friends of the deceased): The meter was not at all affected by the explosion. I had the gas burning in the house next day.

Police-constable *Tuffin*, 35 P Reserve: About a quarter to seven on the evening of the 31st of December I was in Clarendon Street, Pimlico, and was informed that an explosion of gas had occurred at 48, Stanley Street. I immediately proceeded there, and on entering the hall passage I saw the deceased sitting on a chair, supported by persons on each side. I inquired if the daughter had been seen after, and received an answer in the affirmative. The medical man having arrived, she was ordered to be removed to the hospital immediately. I procured a cab and brought both mother and daughter here. The deceased was sensible at the time, but she and her daughter were much disfigured in the face and hands. She said nothing whatever to me in reference to the explosion. I afterwards returned to the house, and found that the windows and door in front had been blown out. I did not make any further examination of the damage done.

Mr. *Kay Shuttleworth:* I am one of the house surgeons of the hospital. I saw the deceased on admission. She was quite sensible, and able to answer rationally, but suffering from shock. She was burnt all over the head and face, and her hair dropped off when touched. Every part of her body not covered by her dress was burnt, and her clothes were almost entirely destroyed, and fell into rags. She was immediately put to bed

and wrapped in cotton wool, opium and stimulants being administered. She recovered rapidly from the shock, and went on well for the first two or three days. On the Wednesday she became feverish and delirous. On Thursday I found her in an exceedingly weak state, and though she recovered by the use of stimulants, she remained delirious, more or less, till the Saturday evening, when she died between 7 and 8 o'clock. I should say the cause of death was evidently the shock produced by the burning. There has been no *post morten* examination, as such extensive burns were quite enough to account for death.

Mr. *W. Millwood:* I am an inspector of gas in the employ of the Chartered Gas Company. I examined the premises in Stanley Street after the explosion the same evening. I found the pavement in front damaged; there was glass broken, and a great amount of disorder in the basement. I immediately reported the case at the works in Horseferry Road to Mr. Pierson, the foreman, and requested him to send men to repair the damage, which he did. I saw the men open the ground down to the main, which was found to be fairly broken through. It was a fracture of the iron itself, and not a breakage at the joint. It must have been broken with violence, and the escape of gas from it would cause an explosion on getting into the lower part of the house. The opinion I formed directly was that the passage of the steam-roller caused the fractures. I cannot account for it in any other way. I observed that the meter in the house was not injured at all. I examined that and the connecting-pipes.

Mr. Cass: You say the main was broken. Was it crushed in or broken quite across?

Witness: It was dark at the time, but it seemed to me that it had sunk a little, and then snapped fairly in two.

Mr. Cass: How long had this main been down?

Witness: I do not know; many years, I should think.

Mr. Cass: Did the pipe seem brittle at all?

Witness: No, it seemed a very good pipe.

Mr. Cass: What depth was it in the ground?

Witness: I should imagine, speaking from memory, somewhere about 3 feet.

Mr. Cass: What was the soil above the pipe?

Witness: The usual earth.

The Coroner: Was the pipe afterwards repaired?

Witness: The part was cut out and a new length put in. I do not know how much was cut out.

A Juror: What was the size of the pipe?

Witness: It was a 3 or 4 inch pipe; about the usual size employed for a private street, where the consumption is moderate.

Mr. *Samuel Pierson:* I am the foreman at the Westminster station of the Chartered Gas Company. On the 31st of December I was called to No. 48, Stanley Street, about half-past 7 o'clock, and went there with five men. I set them to work opening up the main. I then went into the premises. The gas was at that time alight, burning through the back of the vault—through the brickwork from the street. When we got down to the main we found it broken clean in two—not smashed in. It was out of its position, having sunk down about 8 inches from the level. I did not notice particularly, as it was dark, whether the ground above had sunk down. We tied up the broken main with a cloth and white lead, and left everything secure temporarily before going away. As soon as we stopped the fracture in the main, the light in the vault went out. No doubt the fracture was the cause of the escape of gas in the cellar. From the way in which I found it, I should say the fracture was caused by the steam-roller going over it. The roads are very soft there in wet weather.

The Coroner: Perhaps a heavy waggon going over it would do the same?

Witness: There are not many heavy waggons in that neighbourhood.

The Coroner: Would not a heavy furniture van do it?

Witness: No; I think not. I do not think anything would do it but the steam-roller.

Mr. Humphrey: Was the pipe, otherwise than being cracked, in good order.

Witness: Yes, in every appearance.

Mr. Humphrey: Afterwards you cut the piece out, and put in a new length?

Witness: Yes.

Mr. Humphrey: But that night being New Year's eve, you repaired it temporarily, and kept a watchman on all night?

Witness: Yes.

Mr. Humphrey: When was the pipe cut out?

Witness: We had the main entirely stripped on the Monday, and thoroughly repaired it.

By the Coroner: The pipe seemed to be in a good condition, and not rusted or cracked.

Mr. Humphrey: The steam-roller has a very concentrated weight over a 4 feet span, whereas a waggon distributes the weight.

A Juror: Have you ever known cast-iron pipes break in a similar way?

Witness: Yes, on several occasions, but they were not brought under notice.

The Coroner: Did you ever trace them to their particular causes?

Witness: We never traced it.

Mr. Humphrey: Probably in those cases there was no explosion?

Witness: No.

A Juror: When you took the pipe out, could you tell whether it had been recently cracked, or whether it had been cracked some time?

Witness: It was a new break.

A Juror: Can you account for the smell of gas in the cellar six months prior to this?

Witness: No.

The Coroner: The smell was so slight that the witness was doubtful whether it arose from the gas or the sewer.

A Juror: Are you satisfied that this was a fracture all at once, or that it had taken place gradually?

Witness: It is my opinion, from the look of the metal, that it was a snap.

A Juror: Did you notice any subsidence of the soil?

Witness: It had gone down eight inches. The ground was very soft and wet. The heavy rains had made the road very soft, and more liable to sink than in dry weather.

By Mr. Cass: The pipe at the point of fracture was 8 inches lower than the level of the other parts. It was a 3-inch pipe, and taking a span of 30 feet, it had dropped 8 inches. The gas passed just the same. There would be two or three joints in that span, and no doubt the joints had sunk with the main. The pipes are about 9 feet long. We stripped five or six of these lengths.

The Coroner: Might not the joints be a little drawn, so as to allow of a little escape of gas beforehand?

Witness: There was no smell at all.

Mr. Cass: How far are these pipes laid below the surface?

Witness: Three feet three inches; and there was a drop of 8 inches where the fracture was.

Mr. Cass: How far was the pipe from the kerb?

Witness: From 2 feet 6 inches to 3 feet. The steam-roller comes into the kennel, which runs 15 inches from the kerb.

By the Coroner: The pipe was 2 feet 6 inches from the wall at the back of the vault. It would depend upon the nature of the soil how long the gas would be in percolating through. I should not judge that this fracture had existed for a week. No complaints had ever been made to me of a smell of gas on the premises. I have had charge of the district for seven years. If there had been complaints made to any of the men they would be reported to me.

Mr. Cass: Do you think it possible that this fracture might have existed for six weeks?

Witness: No; the iron was too clean for that. The wet would have made it rusty, but it did not look rusty.

The Coroner then summed up the case; and the jury, having consulted for a short time, returned as their verdict—"That the deceased came to her death by an explosion of gas, caused by the fracture of a main-pipe, but as to what caused such fracture there is no evidence to show."

ON THE BEST AND MOST ECONOMIC METHOD OF LAYING MAINS GAS-TIGHT, AND OF DISCOVERING AND REMEDYING LEAKAGES.

By M. Monnier, late Engineer of the Marseilles Gas-Works.

[*Mémoire* to which a Premium of 250 francs was awarded by a Member of the Committee of the *Société Technique de l'Industrie du Gaz en France.*]

This work is divided into two parts.

In the first are given the principal sources of loss of gas, designated by the term "leakage."

In the second are indicated the precautions to be taken, or the rules to be followed, in laying mains and keeping them in repair.

Part I.

We designate generally by the term "leakage" the difference existing between the quantity of gas produced by the works and that which is actually charged to the various consumers. This difference is the result of numerous causes, which we are now about to analyze.

1.—*Errors in the Valuation of the Quantity of Gas Manufactured.*

If we wish to form a correct estimation of the actual extent to which leakage takes place, it is evident that the first condition to be fulfilled is to measure with precision the amount of gas made and the amount sent out for consumption.

As the valuation of the make of gas by means of the gasholders gives only erroneous and uncertain results, we shall here simply speak of measurement by the station-meter.

Station-meters are but little liable to derangement, and, once regulated, do not generally require any further attention than the maintenance of the water at its normal level. The errors which occur in the registration of the amount of gas made most frequently arise, not from the inaccuracy of the measuring apparatus, but from the influence of the temperature upon the volume occupied by the gas, of which generally we do wrong not to take account. It is understood, in fact, that if, as is ordinarily the case, the gas is measured at the works and in the town under different conditions of temperature and pressure, the valuations can do longer be directly compared one with the other, and it will be absolutely impossible to form even an approximate idea of the extent of the actual leakage or loss of gas.

If we let

V represent the volume which a certain quantity of gas occupied at the works, at the temperature of 5^0, and under a manometric pressure of p_1 millimètre of water ($0{\cdot}0735\ p_1$ mm. of mercury), the barometer standing at H_1 mm.;

V_2 the volume the same quantity of gas occupied in the town at the temperature of t_2^0, and under a manometric pressure of p_2 millimètres of water ($0{\cdot}0735\ p_2$ mm. of mercury), the barometer standing at H_2 mm.;

Z_1 Z_2 the tensions at t_1^0 and t_2^0 of the vapour of water contained in the gas, which may be considered as saturated with vapour;

we shall have, according to Gay-Lussac's law—

$$\frac{V_2}{V_1} = \frac{(H_1 + 0{\cdot}0735p_1 - Z_1)\ (1 + 0{\cdot}00366t_2)}{(H_2 + 0{\cdot}0735p_1 - Z_2)\ (1 + 0{\cdot}00366t_1)}$$

For example, if we let

$H_2 = H_1 = 764$ millimètres,
$p_1 = 150$ millimètres of water,
$p_2 = 25$ millimètres of water,
$t_1 = 35°$, whence $Z_1 = 41{\cdot}8$ mm.,
$t_2 = 15°$, whence $Z_2 = 12{\cdot}7$ mm.,

we shall find

$$\frac{V_2}{V_1} = \frac{733 \times 1{\cdot}0549}{753 \times 1{\cdot}1281} = 0{\cdot}91$$

That is to say, that if the gas made has been measured at the works at 35° C., which may occur in the spring, and when it arrives at the consumers meters its temperature has been lowered to 15°, 100 cubic mètres of gas measured at the works will not represent more than 91 cubic mètres measured in the town, and the *apparent* loss will be 9 per cent. It is evident that the difference will not always be so great; but the example cited shows clearly that if we wish to arrive at an exact estimation of the actual extent of the leakage, we must first of all consider the methods of measuring the gas made and the gas sold under conditions of temperature and pressure as little dissimilar as possible, and making certain corrections in the volumes of gas registered by the meters. These corrections, moreover, do not present any difficulty, as it is unnecessary to seek to give them an exactness of which the other data of the question do not admit. The following mode of operation is very simple, and gives results sufficient for all practical purposes.

It will be admitted, perhaps, that the gas in its passage through long pipes acquires the temperature of the soil through which it passes, and that consequently it is at this temperature when measured by the consumers meters. Let us suppose, for example, that the average temperature of the town in which we are now assembled is 14·1° C.; it will be sufficient to bring to this temperature all the volumes registered by the station-meter, so that it may be possible, at the end of each year, to ascertain the quantity of gas really lost. It is true that we could go through this process each month, bringing the volumes to the mean temperature of the month; but that would be of no use, on account of the difficulty of taking the registrations of all the consumers meters coincidently with the closing of the monthly account-sheets of the gas made and sent out. Moreover we shall take for the height of barometer the average pressure of the place where we now are, which in the case under consideration is 760 mm. The mean manometric pressures under which the gas is measured at the works and in the town being known (here 150 and 25 mm. of water), it will only remain to note the temperature of the gas as it passes into the station-meters. This observation is within the capacity of every foreman of works, and may be made four times a day—at six in the morning, midday, six in the evening, and midnight—concurrently with the reading of the index. The mean of these four observations is taken as the mean temperature of the gas made in the 24 hours.

The volume V_1 registered by the meter, is corrected to the theoretic volume V, at the standard temperature and pressure, by means of Gay-Lussac's formula given above:—

$$V = V_1 \times \frac{(H_1 + 0{\cdot}0735p_1 - Z_1)(1 + 0{\cdot}00366t)}{(H + 0{\cdot}0735p - Z)(1 + 0{\cdot}00366t_1)}$$

in which we make

$H = H = 760$ millimètres,
$p_1 = 150$ millimètres,
$p = 25$ millimètres,
$t = 14{\cdot}1°$, whence $Z = 12$ millimètres,

Z_1 and t_1 being alone variable.

In calculating once for all the value of the second factor for different values of t_1 we shall only have to multiply V_1 by the coefficient corresponding to the mean temperature observed, to obtain the volume V_1 corrected.

The following extract from the table in question is given as an example:—

Temperature of Gas at Station-Meter.	Coefficient of Correction.*
10 deg. C.	1·030
15 ,,	1·007
20 ,,	0·985
25 ,,	0·960
30 ,,	0·950
35 ,,	0·906

Instead of making every day the calculation we refer to, one might be satisfied, without great inconvenience, with inscribing the coefficient of correction corresponding to the mean temperature observed, and making the reduction at one stroke at the end of the month, by applying to the total make the mean coefficient of the month.

We here mention the advantage this method of proceeding presents, even from the point of view of the control of the manufacture, only as furnishing a certain basis for the comparison of the yield of gas in different months of the year.

2.—*Errors in the Valuation of the Quantity of Gas Sold.*

Gas is sold either by burner at so much an hour, or by meter. The former mode, which is now scarcely ever adopted for the sale of gas to private consumers, being the only one applicable to the public lighting of towns, it is unnecessary here to insist upon the importance of keeping the consumption of these burners within the strict limits corresponding to the stipulated price per burner and per hour.

The various arrangements adopted to obtain this result may be divided into three groups:—

(*a.*) Stopcocks.
(*b.*) Pressure-regulators.
(*c.*) Regulators of consumption, or rheometers.

Each of these arrangement possesses advantages and disadvantages to which we shall content ourselves with calling attention, without entering into amplifications which would be beyond the scope of the present memoir.

The employment of the stopcock permits the consumption to be kept constant only when the pressure behind the stopcock is very nearly invariable during the continuance of lighting, which is not generally the case; neither is it applicable except when the Municipality allow variations in the amount of gas consumed at the burners during the evening hours, provided the mean consumption remains within the prescribed limits. This method of proceeding presents the incontestable advantage of allowing a more rational distribution of the light over the hours of the evening and night with the minimum consumption of gas. The employment of the stopcock allows, in short, of the almost instantaneous modification of the intensity of the light by a change in the initial pressure, thus providing the works with the means of concealing, in certain cases, an accidental defect in the quality of the gas, until the remedy could be applied. On the other hand, the employment of stopcocks for regulating the flames requires a practised and attentive staff of servants, and constant supervision, under the penalty of soon seeing the consumption of the burners exceed the regulation limits. It is, moreover, to be rejected at all points of the mains where the pressure is subject to considerable variation in the course of the same evening, on account of the necessity which would arise for regulating the flames to an average consumption higher than the amount stipulated for, under penalty of having at certain hours absolutely defective lighting.

The object of the pressure-regulators, as their name indicates, is to maintain beneath the burner a constant pressure, which, however, it is possible to vary by modifying the weight on the inlet-valve. As, notwithstanding all the care that has been bestowed upon their manufacture, burners of the same size do not consume exactly the same amount of gas at a determined pressure, there is generally given to the regulator a weight slightly above that which corresponds to the normal consumption of the burner, the consumption of the latter being regulated by means of a stopcock placed between the burner and the regulator. Beyond irregularities which may occur in the action of the apparatus, in consequence of the alteration of the flexible membrane forming its essential part, these regulators present the disadvantage of requiring to be adjusted afresh each time the burner is changed. Their only advantage is that they allow variable pressures and rates of consumption to be obtained from the same apparatus by modifying the weight on the membrane or the opening of the stopcock.

The object of the regulators of consumption, or rheometers, is to ensure the constancy of the volume of gas consumed, whatever kind of burner may be employed, and at whatever pressure the gas may be supplied, so long, be it understood, as such pressure does not become too low to stop the action of the rheometer. These apparatus are called upon to render great service to gas industry, and their application to public lighting purposes cannot be too strongly recommended, as their employment would result in the complete removal of one cause of considerable loss, and at the same time do away with a subject of frequent contests between companies and municipalities Whichever of these systems be employed, the work of successively inspecting and cleaning, at least twice a year, all the rheometers placed upon the mains, ought not to be neglected; it does not present any difficulty, and occasions only an insignificant expense.

We will now make a few observations on the sale of gas by meter. Although this question is closely allied to that of leakage, we cannot, without exceeding the limits of this paper, enumerate and discuss here the various arrangements which have been proposed or adopted to effect the removal of the causes of error in the measurement of gas at the meter. Let it suffice for us to say that the meter, as at present sold by the majority of French manufacturers, renders frauds very difficult, if not impossible. Practice, however, has not yet definitively sanctioned any of the arrangements proposed to prevent variations in the level of the water in the meter, or to render the correctness of the measurement independent of the constancy of this level. Let us add, however, that in well-organized gas-works care will always be taken to remedy this relative imperfection by constant supervision, the expense of which is largely compensated for by the augmentation of the receipts which results from it; for, while the errors that may be committed in the measurement of the amount of gas made cause no other inconvenience than the prevention of an exact estimation of the leakages, without in any way modifying their absolute value, the differences resulting from incorrect measurement at the point of consumption may be of much greater importance.

3.—*Loss of Gas from the Mains.*

If, on the whole, it is not very difficult to lay a service of mains gas-tight, it may be said that it is not possible to preserve it, for any length of time, in that state of perfection. But the inconveniences and damage of every kind resulting from a defective service of mains are so serious that all the efforts of intelligent gas managers should be directed to reduce these losses to a minimum.

Before entering upon a discussion of the precautions to be taken and the rules to be followed in laying and keeping in repair, under the best possible conditions, a system of gas-mains, it is advisable to say a few words on the principal causes, permanent or accidental, under the action of which there is a tendency to the production of leakage.

Gas-mains being generally placed at a very slight depth, are subject to the influence of the changes of atmospheric temperature. The coefficient of lineal expansion of cast iron being equal to 0·0011 from 0° to 100° C. A difference of 12° in the temperature of the pipe, which may be considered as the minimum of the variations from one season to another, will give rise to an expansion or contraction of 13 centimètres (5 inches) per kilomètre (1094 yards). If any obstruction prevent this movement from taking place freely, the result will be either a rupture or a disjointing of the pipe. In the most favourable case—that is to say, supposing the variation of length to be distributed uniformly over all the pipes, these successive expansions and contractions would affect the soundness of the joints more or less rapidly, according to the system adopted and the care taken in their formation. The disturbance of the soil in streets where the traffic is great, acts in a similar way, and with so much greater force in proportion to the proximity of the pipe to the surface of the ground.

The works which are carried on under the soil of the public ways (such as the construction and repair of sewers, water-pipes, &c.) are a frequent cause of damage to the gas-mains, either at the time of their execution, or in consequence of the settlement of the ground which often results from it.

To these general causes there is sometimes added the accidental corrosion and decomposition of the iron mains by the influence of the chemical action set up by the special conditions of the soil wherein they are laid.

In fact, there is no doubt that the physical phenomenon known by the name of *diffusion* exercises over the leakage an influence so much greater because of the extent to which the preceding causes, by disturbing the system of mains, will have augmented the porosity of the joints.

It is known that diffusion consists in the property gases possess of mutually penetrating from their surface of contact, until the density of each shall have become the same in each point of the total volume occupied by the mixture. Experience has shown that even when the two gases are separated by a diaphragm, the pores of which offer considerable resistance to their passage, reciprocal diffusion nevertheless takes place through this diaphragm with tolerable rapidity, which is proportional (1) to the difference of the pressures above and underneath the diaphragm; (2) to a coefficient of friction depending upon the nature of the diaphragm, but which is sensibly proportional to the square root of the product of the specific gravities of the two gases in contact.

In the particular case under consideration—that is to say, illuminating gas and air—this coefficient will be proportional to $\sqrt{\frac{1{\cdot}000}{0{\cdot}420}} = 1{\cdot}54$; in other words, there will come out 1·54 volumes of gas, and there will re-enter one volume of air, the absolute quickness with which the diffusion will be produced depending besides upon the nature of the partitions through which it operates.

It is to diffusion that to a great extent may be attributed the rapid impoverishment of the gas which has been stored for some time in a gasholder, as well as the diminution observed in its volume, although no apparent escape can be detected.

If in a main-pipe that is not kept constantly charged, the gas loses its illuminating power, it is because through the joints and pores of the pipes there occurs an exchange of gas and air at the rate of about 1½ volume of the former to 1 volume of the latter.

(*To be continued.*)

* To bring the volume observed to the temperature of 14·1° and to the manometric pressure of 25 millimètres.

"COMMISSIONS."

The following letter has appeared, amongst others, in the columns of *The Times* during the past week:—

To the Editor of "The Times."

Sir,—If anything can be done to stop the system of illegitimate commissions, it will be by letting in the light upon it through your powerful journal. It is not for me to assume a tone of "virtuous indignation" at the state of things so disclosed, for I am a member of a firm which, in its transactions with public companies (chiefly gas companies) and corporations, has for more than 20 years paid large sums in this way, and whose business would not probably have grown to its present dimensions had these payments been refused. I have always exerted myself to prevent the extension of the system, but have only succeeded to the extent of limiting and reducing these payments. I am far from satisfied with this, however, as the bad principle at the root of the system remains untouched till the system itself is utterly abolished.

I am able to state that in most gas-works (the exceptions being very few indeed) very little is purchased which does not pay a toll to one or more of the officials. Coals, pipes, fittings, meters, apparatus, and material of every kind are all subject to a "commission," and it is vain for the officers of any company to pretend (as is often done) that these payments are no loss to their employers, but merely a deduction from the profits of the seller—a statement so evidently absurd that I will not waste your space in refuting it. But these commissions indirectly produce losses far greater than their own amount. It is within my own knowledge that, with a view to their receipt, managers of gas-works are often induced to overstock with apparatus and material on leaving one situation for another, and that it is quite the rule for a new manager to find that his predecessor has provided him with everything likely to be required for months to come, and that some of the articles are not such as the newly-appointed manager would himself have purchased. But he can often make no complaint, for did he not do the same thing in the situation he has just left? These commissions also induce the purchase of new material and apparatus and the breaking up and disposal of old, merely to obtain for the manager the "usual commission," and for the same purpose extensions of works and alterations of plant are entered upon, either before they are called for, or to a greater extent than required, the fact being that the manager's interest is opposed to that of the company, as in most cases any increase of salary as a reward for good management would not nearly equal the amount to be received on commission.

When consulting engineers are called in, they receive a commission on

the outlay they incur, from the gas company for whom it is incurred (which may or may not be a wise mode of payment, but is perfectly legitimate), but it is not so well known that they also get a commission from the contractors who execute the work, and against this practice the system of tenders and contracts offers but a feeble protection, while "the lowest tender is not necessarily accepted."

It is often said that companies are to blame in paying small salaries, which have to be supplemented by the means referred to, and there may be some little truth in the remark; but I know of a few cases where poorly paid and thoroughly efficient men have resolutely declined commissions, and many cases where well paid and less efficient men have not only accepted them, but could not be approached on any other footing. Directors of public companies cannot raise their officials above temptation by simply increasing their salaries; but they would be great gainers were they to do so, on the distinct understanding, constantly kept in view, as a condition of the appointment, that commissions either in money or gifts were entirely to be declined, not only by the officials themselves, but also by members of their families, to whom these payments are sometimes made when the official himself desires to deny that he has received them.

It is probably impossible for any one firm to stop the system, as in doing so they would only stop their business and increase that of others, who would be willing to do what they declined. Such a proceeding, therefore, however honourable, would be merely an ineffective protest; and were persons who, like myself, feel strongly on the subject to withdraw from business where these payments are usual, they would not only lose personally (which it might be a duty to do), but would probably do more harm than good by their withdrawal of an influence, always ready to be exerted, for the limitation and abolition of this obnoxious system.

(Signed) A Commission Abolitionist.

IMPROVEMENTS IN STREET LIGHTING.

[From the *Manchester Examiner*.]

An improvement which is expected to yield important results is about to be carried out in the construction of the street lamps in the borough of Salford; and it is believed that it will prove that the gas manufactured by the corporation is much better than that used in many towns where at present the street lamps give a better light. In the eastern, midland, and southern counties, and in London, the streets are, generally speaking, better illuminated than in Salford; but we are informed that the gas used in these places is, as a rule, forty to fifty per cent. inferior in lighting power to that manufactured in Salford. The illuminating power of Salford gas is equal to that of about 20 candles, reckoning according to the standards of comparison universally adopted—namely, a jet consuming five feet of gas per hour, and candles each of which burns 120 grains of sperm per hour. Taking London as a fair sample of the places where the street lamps give more light than in Salford, and where, notwithstanding, the gas is of inferior quality to that in the latter borough, it appears that the illuminating power of the gas supplied by the producing companies varies from 12 to 16 candles. It may be mentioned incidentally that the chief reason of the superiority of the Salford gas is that cannel is used in making it, as is also the case in Manchester, while in the places with which the sister borough has been compared the gas is manufactured simply from coal. The explanation of the apparent inconsistency between the quality of the gas and the light given by the street lamps is very simple; and as Manchester occupies about the same position as Salford in relation to this question, it will probably be interesting to examine the explanation. The secret of combustion of gas so as to obtain from it the greatest amount of light is, we understand, that it should be burned at what has been called an inappreciable pressure at the point of ignition. To accomplish this object the burner should have a large opening as compared with the volume of gas which is to issue from it. In Salford, however, the practice has generally been to use small burners for the public lamps, and to force large volumes of gas through them, the result being that the fluid has actually passed through the burners faster than it could be consumed, and thus much of it has been wasted. After many experiments conducted by the Salford Gas Committee, with the assistance of Mr. Samuel Hunter, the manager of their works, the committee have decided that, to secure the greatest possible amount of light from the gas used, the whole of the street lamps in the borough shall be fitted with Sugg's patent lamp-governor, the cost of which is only about 3s. This invention is to be fixed just beneath each burner. All the gas consumed will pass through it, and it can be regulated so that, whether the pressure from the main be great or small, whether the tap which the lamplighter manipulates be wide open or only partially open, the amount of gas passed through towards the flame will not vary. Two lamps fitted with the new governor burners, as they are called, have been erected in New Bailey Street, one being near the station, and the other at the corner, a few yards away. The experiments made with the two kinds of burners at present in use, and with the governor burner, gave some interesting results. One of the existing burners consumes 3½ feet of gas each hour, and gives a light equal to that of 5·4 candles. The other, burning 4½ feet of gas, yields a light equivalent to that of 8·8 candles, while the new governor burner consumes 3½ feet, with the illuminating power of 10·7 candles. Adapting these figures to the standards, as we have already described them, it appear that the light given by the two old burners respectively is equal to 8 candles and 9½ candles, while that of the governor burner corresponds to 15 candles. The advantages, therefore, expected from the alteration about to be made are an increased amount of light from the street lamps, a saving of gas, and a saving in the ratepayers money. Mr. Hunter further proposes to improve the lamps by reducing their height from 12 feet to 10 feet, so as to place the light nearer the traffic, by adopting a form of pillar which is more ornamental and casts the least possible amount of shadow, and by making the lanterns more graceful than at present, and marking the lanterns with the names of the streets in which they may be placed. He calculates that the cost of replacing every lamp in the borough with one of the pattern he recommends would not add more than 4d. a lamp per year to the expenditure of the corporation, including the price of the governor. No decision, however, has been come to by the authorities, excepting with respect to the governor.

Birmingham Water Supply.—Dr. Hill, the medical officer of health for Birmingham, reports that the water supplied to the town during December was slightly turbid, and the organic nitrogen and nitrates were higher in proportion than they have been for some time, probably owing principally to the late rains.

New Gas Company.—A company denominated the "Improved Air Gas Company" was registered on the 23rd ult., with a capital of £10,000 in £10 shares, for acquiring and working certain letters patent, dated June 3, 1872, June 5, 1872, March 8, 1873, and Oct. 30, 1873, numbered respectively 1679, 1708, 843, and 3526, granted to Messrs. Charles Weightman Harrison and Alfred Horatio Harrison, for inventions relating to the manufacture and use of air gas. Also to take over the business of Harrison and Company, Limited, or any other business established for working the same.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(from our own correspondent.)

The business of the week, although quiet and not of any particular magnitude, has been on a steady scale, and is thought to promise well for the immediate future. Pig iron is in especially good and firm request, some of the local and district makers being evidently determined not to enter into any forward arrangements unless at a clear advance of at least 1s. per ton all round. The periodical report of the Leeds Chamber of Commerce states that, although this disposition to advance pig iron exists, there is nothing whatever to warrant the advance. The same thing may be said of the local trade, so far as forge pig is in question; but the foundries are so well engaged, as a rule, that the steadiness of prices is explained.

At most of the leading foundry establishments in Derbyshire and South Yorkshire there is a good deal of work in hand, and a fair number of orders on the books, hence there are in several directions rumours of intentions to re-start additional blast furnaces. It, at any rate, appears certain that the present is a favourable time to place contracts for pipe and other work of that class, inasmuch as there is every probability that prices will go up somewhat in the course of the next three or four months.

The coal trade is quiet, and will, almost without doubt, remain so throughout the whole of the year. Taking into consideration the great number of new collieries which have just become productive, and the extensions of previously existing pits, it need be no matter for surprise that the competition should be keen, and prices ruinously low. There has been a rumour put in circulation, alleging that South Yorkshire steam coal is specially liable to spontaneous combustion and explosion, but investigation shows that the statement is baseless.

Several pits in both counties have been flooded by the late rains, and some remain so still.

THE LANCASHIRE COAL AND IRON TRADES.

(from our own correspondent.)

Both the coal and iron trades of this district continue in a depressed condition; the supplies offering in the market are much in excess of the demand, notwithstanding it is only in exceptional cases either the ironmasters or colliery proprietors are working up to their full production, and although the quoted prices do not show any material reduction, there is a want of firmness in the market.

So far as coal is concerned, there appears to be more of the best qualities offering in the market than was the case a few weeks back, and for immediate deliveries sellers would accept rather lower prices to secure good orders; but, with the winter still before them, they are not disposed to enter into forward contracts at the present low prices. Manufacturing classes of fuel continue difficult to sell, both common round coal and engine fuel being very plentiful, and there is a considerable amount of competition in the inferior class of burgy and slack. In the Wigan district the average pit prices are about as under:—Best Arley, 11s. per ton; Pemberton four-feet, 9s.; common Wigan mines, 7s. 6d. to 8s. 6d.; steam coal, 6s. 9d. to 7s.; burgy, 5s. 6d.; and ordinary slack, 3s. to 4s. per ton.

In the iron trade the local smelters continue firm at late prices, as their present small production is pretty well sold for the next couple of months; but they are almost out of the market, owing to the low prices at which north country pig iron is being offered by merchants in this district. Lancashire pig iron delivered into the Manchester district is quoted at about 56s. 6d. to 57s. 6d. per ton for No. 3 foundry, and 55s. to 56s. per ton for No. 4 forge. The finished iron trade continues steady in price, local bars delivered into the Manchester district being still quoted at £6 17s. 6d. to £7 per ton, according to quality; but there is no push, and both founders and engineers complain that they are very slack.

THE COAL AND GENERAL TRADE OF THE NORTH.

(from our own correspondent.)

The coal trade of the North of England recovered last week from the depression of the previous fortnight. Nearly all the contracts for best gas coals have been concluded for the year. The latest were made at about 8s. 6d. per ton. During last week there were very heavy sailings of coal-laden vessels bound to all parts of the United Kingdom. Many small cargoes of gas coals which had been on board ship, bound to the bye-ports, from eight to ten days, were got away, and the steamers also cleared out, so that the coals in transit have been very heavy. Under these circumstances south country merchants keep out of the market, and a very limited business indeed was transacted last week for immediate delivery either in gas or house coals to be sent away in small cargoes. The price of gas coal remains about the same—namely, about 9s. for the best sorts, and from 6s. 6d. to 7s. 6d. for moderate qualities. The local demand for coals is not at all reviving, and one or two of the colliery companies which have been struggling on for the last two years against adverse times are likely to wind up. The main feature of interest in relation to the steam coal trade at present is the prospect of a reduction of the production of small coal, which may reach outside that trade and strengthen the value of inferior coals generally. But that will not take place just now if at all. The steam coal trade is in a very poor way. Most of the pits are working short time, and there is no prospect of improvement until the middle of March.

Notwithstanding the departure from the Tyne of 250 coal-laden vessels, the supply of tonnage has been quite in excess of the demand. Rates have hardly been maintained. For steamers they have fallen to the following low level:—London, 4s. 3d. to 4s. 6d.; Rochester, 4s. 9d.; Boulogne, 5s. 1½d.; Havre, 6s.; Dublin, 8s.; Rouen, 7s. 6d. per ton. On account of the bad trade, home outward coal business to the Mediterranean is pretty stiff, and the higher rate of freight has to be paid to induce steamers to proceed out.

The iron market is pretty firm in the Tyne. Common bars, £6 15s.; merchant bars, £9 per ton; ships plates, £7 10s.; angles, £7 10s.; rails, £6 5s. per ton; pig iron local make, No. 1, 55s.; No. 3, 48s. 6d., net cash; Scotch warrants, 57s. 4½d. per ton. The local demand is very well maintained. In the lead market here pig lead is sold at £22 10s. per ton; dry white lead, £26 5s.; red lead, £22 5s. per ton. In the chemical market prices still have a downward tendency, and the amount of business doing is very limited. For want of orders makers are obliged to warehouse largely.

TRADE NOTES FROM SCOTLAND.

(from our own correspondent.)

Complaints were made at the last meeting of the Town Council of Hamilton that the town had been left in darkness two or three times during the last month or so. On the evening of Saturday, the 6th inst., not a lighted lamp was to be seen. Mr. Tainsh, convener of the Corporation Gas Committee, explained that the gasholders at the works were too small. About 130,000 cubic feet of gas were manufactured daily, and yet there was only accommodation for 90,000 feet; consequently at night they

had to change the holder, and he found that on the night in question, when the change was being made, one of the holders would not act. He sent a man to get the lamps lighted after they went out, and he could say, although it was bad enough, all the lamps were not out. In reply to the Provost, Mr. Tainsh said they would have to face the difficulty of providing against the risk of such a state of things again occurring by providing a much larger holder. Such a one as was needed would require to be 90 feet in diameter, and would cost £1000. He further said that the gas was costing for production only 1s. 1½d. per 1000 feet; and in reply to another member of council who expressed a desire for better gas, he said if they made it better it would not burn in the jets, its illuminating power being equal to 30 standard candles.

At the last meeting of the Town Council of Paisley Mr. G. R. Hislop, manager of the Corporation Gas-Works was in attendance to present and describe the plans which he had designed for a new gasholder, the erection of which he considered was imperative, in order to furnish the town with an adequate supply. The proposed holder would accommodate 670,000 cubic feet of gas, and the cost would be from £14,000 to £15,000. The work would require to be commenced at once, as it would need almost nine months to complete it.

The Gas-Works Committee of the Dumbarton Town Council reported, at a meeting held last Wednesday, that they had taken offers to telescope the old 50 by 16 feet gasholder, and to put in a new 10-inch inlet and 12-inch outlet-pipe in same, which was considered necessary by the manager, Mr. M'Gilchrist, as a matter of safety, to afford sufficient storeage. The provost moved the adoption of the report. Several of the members thought the present an inopportune time to make the proposed alterations, but the members of the committee assuring them that the alteration were absolutely necessary, the Provost's motion was agreed to unanimously.

The Police Commission of Broughty Ferry met last week, when the manager of the gas-works reported that the average illuminating power of the gas supplied to the town was 29·13 candles.

Mr. J. F. King, city analyst, reported to the meeting of the Edinburgh Town Council held last week, that at his last analysis of the gas supplied to the city he had found that of the Edinburgh Company to have an illuminating power of 30·63 standard candles; hydrosulphuric acid, none; ammonia, distinct traces. The gas of the Leith Company had an illuminating power of 27·83 candles; hydrosulphuric acid, none; ammonia, present. Mr. Steel asked if the council had no power to compel the Leith Company to raise the guality of their gas, as it was always two or three candles below that of the Edinburgh Company's gas, and he did not see why that should be. The Lord Provost replied that the Leith gas was at one time above that of Edinburgh, but Mr. Steel affirmed that it had only occurred once.

The gas supplied from the Glasgow Corporation Gas-Works during the week ending the 6th of January had a maximum range from 25·89 candles to 28·04 candles. On one occasion the minimum was down to 24·30 candles at the Dawsholm station, and down to 24·59 candles on one occasion at the Dalmarnock station.

Last Tuesday evening a meeting of the Hawick Town Council was held, when Provost Ewen stated that in consequence of the complaints about the bad quality of the gas supplied to the town, he had made a representation to the directors of the gas company, and they had promised to give the matter their consideration.

The Lighting Committee of the Arbroath Police Commissioners have just reported to that body that there are 452 public lamps in the burgh, and with regard to lights on common stairs and in closes they recommended that the board should call upon all landlords to erect lamps, and cause the tenants to clean and light such lamps within the burgh.

It would almost seem as if the relative merits of dry and wet gas-meters had not yet been satisfactorily established, if we are to judge by the correspondence which has recently appeared in the leading newspaper published in Edinburgh, a town that is somewhat famous for the production of meters and other apparatus for the supply and consumption of gas. One correspondent, who signs himself "A Jumper," says: "I have just seen a circular that has been issued by a well-known London maker of dry gas-meters, in which it is said that two meters have been in use between 20 and 30 years, and are perfectly correct. If this is so, why need we be annoyed by continuing the use of meters which cause jumping lights? I address you upon the subject, as not long since a paragraph appeared in your journal upon this question, and some of your correspondents may be able to throw a steady light upon the matter." In reply to "Jumper's" remarks, at least three very interesting letters have already appeared, in which the merits of both dry and wet meters have been set forth. One correspondent, signing himself "A Steady Light," says, with regard to jumping lights, that the dry meter is more troublesome than the wet, though not affected in the same way.

The usual monthly meeting of the Dysart Town Council was held on the evening of Monday, the 8th inst., when an animated discussion arose on an intimation from the gas company that they were disposed to sell the gas-works to the Council. Seeing that the Kirkcaldy Gas Company had introduced a 6-inch pipe along the highway to the burgh, and that the Kirkcaldy Company could manufacture gas 2s. 6d. per 1000 feet cheaper than the Dysart Company, the question was postponed for consideration, the clerk stating that no sale could possibly take place until after December next, and that a public meeting would also be required to give an opinion of the inhabitants on the matter.

A moderate amount of business was done in the Glasgow pig iron market in the early part of the past week, but towards the end it began to waver, and steadily to settle down. The foreign demand is very limited in amount. Reductions in price were very general during the week, most of the leading makers taking off 1s. per ton. The market closed on Friday with buyers at 57s. 3d. cash, and sellers 57s. 6d. one month open.

The coal market has been idle during the past week, buyers being shy. There is only a moderate demand for house coal, and prices, as a rule, are unchanged.

Sale of Gas Shares at Cardiff.—A few days ago 57 shares of £25 each in the Cardiff Gas Company were sold by public auction, and realized £88 10s. per share. The dividend on these shares is limited to 7 per cent.

Waste of Water in Dublin.—The *Freeman* states that the average quantity of water sent into the city of Dublin daily, and accounted for in the week ending the 3rd, was 7,255,127 gallons, and the average quantity of water wasted daily in the same period was 5,043,777 gallons.

Glasgow Water Supply.—Dr. Mills, of the Andersonian University, Glasgow, reports that during last month the water supplied to the city from Lock Katrine was of a pale yellow brown colour, and somewhat ferruginous. It contained traces of suspended fibrous matter.

Bradford Gas and Water Works.—At the meeting of the Bradford Town Council, on the 9th inst., the salary of Mr. Binnie, water-works engineer, was raised from £400 to £1000 per year; and that of Mr. David Swallow, gas-works engineer, from £800 to £1000.

Accident at the Rotherham New Gas-Works.—For some time past the Corporation of Rotherham have been extending the old gas-works, and one of the principal new buildings is a purifying-house on the banks of the river Don. Part of the house projects 15 feet over the water, and for the support of the outside wall, a set of cast-iron pillars rose out of the bed of the river. On the girders resting on the pillars was raised, about six weeks since, a brick wall 22 feet high, 14 inches thick, and 61 feet long. In the wall were four 8-feet openings, reaching to within a few feet of the top; and the whole was tied with stone, and bound with hoop-iron. The wall has been "green" ever since it was put up, and consequently it was not deemed safe to put on the roof. That there was ample ground for this fear was proved about half-past seven on Saturday night, Jan. 6, when, owing to the weak state of the wall, caused by the recent rain, and the prevalence of a gusty south-east wind, the whole fell with a crash. The top part fell into the water, but the lower portions, and the piers between the openings, bulged inwards, breaking two girders and two purifier plates. However, the pillars and girders over the water did not move in the slightest degree, proving that the weakness was confined entirely to the work above. The building work has been done by Mr. Jackson, Rotherham, under the supervision of Mr. Goodwin, the gas-works manager, the corporation finding the material. The damage is estimated at £120, which will have to be borne by the corporation. Until the weather becomes more settled, it is not proposed to complete the work.—*Rotherham Independent.*

The Paraffin Oil Trade.—Amid the dulness which prevails at present in our trades and manufactures, it is satisfactory to find unusual activity in one branch of them—namely, in the manufacture of paraffin oil. About twelve years ago there was great briskness in the trade of this article, and the price reached such a height as was never heard of before. This briskness, however, was but of short duration, though it stimulated the manufacture of the oil to an unusual degree. Works sprang into existence in all parts of the country, and the rents and royalties obtained for the shale from which the oil is made caused the proprietors of coal to wish that their minerals were shale instead of coal. Many circumstances at the time contributed to the increase of the manufacture, two of them being that coal and wages were so low as to make it more remunerative. The high price of the oil in this country brought many speculators into the field in America, and the most strenuous exertions made by them to discover petroleum were crowned with success to such an extent as to flood the market with the produce of the wells. District after district was found where lucky adventurers came upon wells which spouted out the oil in such abundance as to render it very difficult to find vessels in which to store it; the result was that a large quantity of it was allowed to run into the nearest rivers and to be carried off to the sea. It is now about three years since one of the most productive of these districts was discovered, which produced so much more petroleum than was required for the consumption of the world that the surplus was stored up; and about a year ago this amounted to about three or four millions of barrels of crude oil. Unfortunately for the manufacturers of paraffin oil in this country, this enormous produce in America took place at a time when coal, wages, iron, and other material required most in the manufacture of paraffin oil, reached an unprecedented price. The cost of production was, therefore, very much increased, while the price of the oil was greatly reduced from the large importations of petroleum from America. The consequence was that considerable losses were experienced by the manufacturers in this country, and some of them succumbed to the adverse circumstances. The survivors struggled on during these disastrous times, economizing in every way, improving the manufacture, and utilizing the waste products. The result was that, even with oil at so low a price as it never reached before, they were able to pay a dividend when the cost of manufacture was reduced by coal and iron, and wages being also reduced in value, though not so low as they were at the commencement of the manufacture of the oil in this country. These companies are, therefore, now in a good position to reap the advantage of the increased price of paraffin oil. Though this increase came rather late in the year for the full advantage of it to be felt this season, there can be no doubt that larger dividends may be looked for, with the certainty of a profitable trade for some time to come. The prospects of the manufacturing trade for the future are encouraging; for the great exertions made for the last year in America to discover more flowing wells, and another oil-producing district, have not been hitherto successful, nor is there any prospect of their being; and so long as petroleum cannot be produced, excepting at the expense of pumping, the manufacturers in this country will be able to compete with those in America, and the oil trade will be profitable. It is expected that in future the price will be a paying one; and, if we may judge from present circumstances, the profits for some time to come will be very large; for the production is not nearly equal to the present consumption, and the large stock of crude oil in America is being rapidly reduced, the reduction in some months being about 300,000 barrels per month. Those best able to judge, from their position, are therefore making great preparations to avail themselves of the expected continued high prices. The two large companies in Scotland have added, and are adding largely, to their plant. It is said that Young's Company have already added plant sufficient to increase their production of oil 25 per cent., and that the Uphall Company have similarly increased their production 40 per cent., and it is expected that there will be further additions. It is further stated that these additions are made without increasing the capitals of the companies. The larger production of oil in this way is not likely to affect the price, for the production in Scotland is so small, as compared with that in America and with the general consumption, that it will require a very large increase in the manufacturing plant to have any material effect. It was calculated a month ago that the whole production of Scotland for a year would not be equal to more than a week's consumption, so that there need not be any fear of over-production from increase of manufacturing plants for some time to come.—*Scotsman.*

Coal Gas and its Application to House Lighting.—A discourse on this subject has just been delivered in the theatre of the Royal Dublin Society by Professor Tichborne, F.C.S., M.R.I.A., gas examiner under the Board of Trade for the City of Dublin. The lecturer began by stating that lighting by coal gas was a comparatively recent invention. It was not until 1810 that a company was formed in London for the supply of the City with gas, and Paris was not lighted with gas until 1820. In those days nothing was heard about the purity of the gas, or about its illuminating power. So that they gave the consumer something at the end of the tube which would burn, that was all that was required. Passing to the composition of coal gas, he showed that it consists of—

	Per Cent.	Relative Weight, Air being 14·47.	
Hydrogen (H) . . .	45	1	Non-illuminating — Lightest substance known.
Marsh gas (CH_4) . .	35	8	Slightly illuminating—"Fire-damp."
Carbonic oxide (CO).	6·6	14	Non-illuminating—Poisonous.
Olefiant gas (C_2H_4) . (and other olefiants).	6·0	14	Highly illuminating, being very rich in carbon.

The impurities found in coal gas chiefly consist of ammonia (NH_3) detected by Hæmatoxylene; sulphide of carbon (CS_2), detected by Triethylphosphine; and sulphuretted hydrogen (H_2S) detected by acetate of lead. This

last impurity is the most important, as it blackens the paint of the houses, discolours the silver plate, and affects the breathing of the inhabitants. The Dublin gas contains a small quantity of ammonia but it is entirely free from sulphuretted hydrogen. For the last two years on only two occasions had he been able to detect any indications of sulphuretted hydrogen. In fact, it was much purer than was required by the Act. On one of these occasions the defect had been discovered, and the remedy had been applied before his messenger got out to the gas-works. The lecturer then proceeded to refer to bye-products of general interest. These are—1, coal tar, the source of "coal tar colours," and carbolic acid. Coal tar colour industry represents now a money value of about £2,000,000 per annum; 100 lbs. of coal give 227 grains of magenta, which will dye 7 lbs. of wool. 2, coke; and 3, ammonium sulphate, which is used in making artificial manures. Passing from thence, he proceeded to speak of the structure of a gas-flame, and described the different burners in use. The Dublin gas, on an average, was 17-candle gas, but that might be burned so as to give only a light equal to four or five candles. He understood that the committee of the corporation, having the charge of the public lighting, proposed to use a No. 1 burner in the public lamps. But he was satisfied that although a slight saving might be effected, the public would not be satisfied. A much better result would be obtained by using an improved burner—a burner which would check the flow of gas to the orifice. Good burners are those in which the gas is checked at the base of the burner, and at some distance from the base of the flame—the orifice for the gas at the flame being greater than the check. The most economical way of burning gas was to have a perfectly free combustion at the tube, with a moderate pressure. If they could not check the pressure in any other way, let them do it at the meter. The lecturer then referred to the intensity of light, and the means of measuring it by the photometer; he then described Mr. Crookes' experiments with the radiometer, and dwelt on the quality of light and its effects on colour and fabrics, explaining how colours rich in the more refrangible or blue rays suffer most by artificial light. He also explained the effects of temperature and atmosperic pressure on gas, and how the increase of temperature decreases the illuminating power, but increased pressure augments it. He gave what he called golden rules for the consumer. These were—1. Read your meter once a month. 2. Never have an excessive pressure on the meter, but also control it, if possible, at the burner. 3. Never keep on old burners. 4. Always have your lights 11 to 12 feet from the ground. Passing on to the question of ventilation and the products of the combustion of coal gas, he explained the causes of gas explosion, and showed how, by a recent invention, the presence of leakage of gas at the meter, where explosions are most apt to occur, is at once made known, and explosions are avoided.

Register of New Patents.

397.—Barrett, J. H., and Hargreaves, L., Halifax, "*Improvements in apparatus for regulating, controlling, and directing the flow of liquids.*" Provisional protection only obtained. Dated Feb. 1, 1876.

This invention consists of two or more taps and pipes, which latter intersect each other and terminate in one outlet-pipe; the separate pipes or branches being connected with separate vessels, from which liquids are to be drawn. Inasmuch as these vessels may contain an unequal quantity of liquid, or be at varying levels, in order to prevent the flow of liquid from one vessel to another, it is necessary that means be adopted to prevent the back-flow, and for such purpose the apparatus as heretofore made and used was provided with a ball-valve contained within a cavity formed by an enlargement of a portion of the separate pipes, such enlargement being at a point between the vessel and the tap of each pipe.

The object of this invention is to so construct apparatus for these purposes as to dispense with the ball-valve, and to render an enlargement of the separate or feed-pipes unnecessary, whereby the construction of the apparatus is simplified, its bulk is greatly reduced, and the ordinary or "standard" unions are available.

In the construction of the apparatus a winged valve and screw-spindle are used, having a casing and entrance and exit ways, the valve and spindle answering the purpose both of tap and check to back-flow; the flow being from the vessel under the wing-valve (which is thus raised), and to the outlet or discharge-pipe, whilst the effect of back-flow or flow of liquid from another vessel is upon or on the top of the wing-valve, which is thus closed, and the entrance of liquid prevented.

401.—Dubois, J. L., Clapham, Surrey, "*Improvements in cocks or taps.*" Patent dated Feb. 1, 1876.

These improvements have reference to that class of cocks or taps in which valves are used, and the object of the invention is to secure increased efficiency in use.

The passage for the flow of the fluid is closed by a duplicate valve applied to and partly formed on a spindle, working between the parts of the cock or tap, and with a flexible diaphragm, the edge or circumference of which is secured by the securing of the dome or cover to such diaphragm and other parts of the valve. To this upper part of the spindle of the valve there is sometimes applied a disc or arms, to act as guides to that part of the spindle in the opening and closing of the valve. The spindle of the valve is acted upon for this opening by a scroll-formed cam turning upon an axis, and operated by a lever arm, mitre, or other tooth gear, or other suitable means. For this motion the scroll is formed so that the increase in the radius thereof is not more than about two-thirds of its smallest radius, and in place of acting by such scroll directly on the upper part of the spindle of the valve, there is applied thereto a rocking-piece, the surface of which, acted upon by the scroll, is extended, and of form corresponding with that of the scroll, so as to obtain sufficient holding for readily retaining the valve at any extent of partial opening; or the upper end of the spindle or the guide thereof acted upon by the scroll is formed of corresponding shape and extent of surface, or with rollers thereto of like correspondence, or with cup applied either above or below the diaphragm, or both; with the cup below the diaphragm the end of the spindle is formed to correspond.

In making the valve in two parts, one part is formed on or applied directly to the spindle, so as to operate in closing a comparatively small passage through the secondary part of the valve, which closes on to the valve-seat.

414.—Adair, W., Liverpool, "*Improvements in and connected with pumps.*" Patent dated Feb. 2, 1876.

In this invention, as means for obtaining a quick-closing valve of small weight, and for increasing the durability of valves used in pumps, where grit or other substances are liable to pass the valves with the liquid raised, a flexible disc valve of india-rubber or leather is employed, and a free feather-lift or like valve perforated, or with its top removed, combined together as one. The flexible disc valve, when the pump is in action, opens and closes quickly, so as to allow the liquid and grit, sand, or like substance to pass freely in an upward direction, but prevents the return of the liquid. The liquid in rising passes the flexible disc valve instead of flowing between the feather-lift valve and its seat as heretofore; hence all abrasion and wear of the valve and its seat are avoided. If, however, any large or bulky object, such as is too large to pass the flexible disc valve, is drawn up with the liquid, the feather-lift valve opens and allows free way to the object. The construction of the compound valve is such that it is complete in itself, and can easily be removed, should the pump become choked below the valve, or should its removal be desired from any other cause.

APPLICATIONS FOR LETTERS PATENT.

5035.—Page, W., Newcastle-on-Tyne, "Improvements in valves, taps, or cocks." Dec. 29, 1876.

5051.—Hart, W. H., Lewisham Road, London, "Improvements in balanced valves for fluids, partly applicable to ordinary cocks or valves." Dec. 30, 1876.

5055.—Gedge, W. E., Strand, London, "Improvements in the manufacture of the hydrocarburets of coal tar, and of the amines derived therefrom." A communication. Dec. 30, 1876.

8.—Stitchbury, F., Leyton, Essex, "An improved method of heating box-irons by a mixture of gas and air." Jan. 1, 1877.

21.—Pinto, F. de C., Kensington Road, London, "Improvements in steam or other fluid motor engines or pumps." Jan. 2, 1877.

25.—Thompson, J., Camberwell Road, London, "Improvements in apparatus to facilitate the cleansing of cisterns or tanks, and for trapping their waste pipes." Jan. 2, 1877.

54.—Bailey, W. H., Salford, Lancs, "Improvements in apparatus for raising or forcing fluids and liquids." Jan. 5, 1877.

57.—Anderson, J., Glasgow, "Improvements in apparatus for the destructive distillation of shale and other substances." Jan. 5, 1877.

79.—Truss, T. S., Eastbourne, Sussex, "Improvements in valves and their arrangement, and in the combination of mechanical actions for working, governing, and reversing the motion of the same as prime movers, and regulating the supply and discharge of fluids to and from the cylinders of fluid motive-power engines of every description, and reversing the motion of the same, parts of which are applicable to pumps." Jan. 8, 1877.

97.—Collinge, T. A., and Paterson, T. O., Rochdale, Lancs, "Improvements in the production of material for and method of purifying coal gas, and in apparatus used for that purpose." Jan. 9, 1877.

103.—Scott, H. Y. D., Ealing, London, "Improvements in the treatment of fœcal matters and ammoniacal compounds for the production of manures." Jan. 9, 1877.

108.—Osmond, S., Bishopsgate Street Within, London, "Improvements connected with supplying water to closets and for domestic uses." Jan. 9, 1877.

121.—Dronier, P., Paris, "Improved means for lighting gas by electricity." Jan. 10, 1877.

130.—Breeden, J., Birmingham, "Improvements in valves and taps or stopcocks, and in hose unions." Jan. 10, 1877.

149.—Ede, G. W., Little Gray's Inn Lane, London, "Improvements in valves." Jan. 11, 1877.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

2870.—Preston, F. P., Prestige, J. T., and Preston, E. J., Deptford, London, "Improvements in pumps and their fittings." July 13, 1876.

2994.—Messenger, T. G., Loughborough, Leicester, "Improvements in valves for the circulation of hot water, which improvements are also applicable to the circulation of cold water, gas, or other fluids." July 25, 1876.

3209.—Peyrouse, Louis de la, Finsbury Circus, London, "Improvements in the manufacture of gas." Aug. 15, 1876.

3655.—Foulis, W., Glasgow, "A new or improved gas-governor." Sept. 19, 1876.

3792.—Johnson, J. H., Lincoln's Inn Fields, London, "Improvements in apparatus for obtaining motive power, which apparatus is also applicable to the condensation and rarefaction of gases and vapours." A communication. Sept. 29, 1876.

4056.—Tylor, A., and J. J. Newgate Street, London, "Improvements in apparatus and arrangements for measuring and recording the movements, speed, and quantity of liquids and fluids." Oct. 20, 1876.

4381.—O'Neill, A., Baltimore, U.S.A., "Improvements in modes of constructing and laying mains and service-pipes for water, gas, and other similar purposes." Nov. 11, 1876.

4422.—Lake, W. R., Southampton Buildings, London, "Improvements in and connected with the pistons of air and gas engines." A communication. Nov. 15, 1876.

4585.—Russell, T., Cleveland Square, London, "A new or improved method of charging and drawing gas-retorts." A communication. Nov. 27, 1876.

4588.—Lake, W. R., Southampton Buildings, London, "Improvements in couplings or connexions for tubes or pipes." A communication. Nov. 27, 1876.

D. BRUCE PEEBLES & CO.,
ENGINEERS,
FOUNTAINBRIDGE WORKS, EDINBURGH,
MANUFACTURERS OF WET AND DRY GAS-METERS;
Patentees and Sole Manufacturers of "PEEBLES' GAS-GOVERNORS,"
FOR STATIONS, DISTRICTS, DWELLING-HOUSES, AND PUBLIC LAMPS,
OF WHICH UPWARDS OF 90,000 ARE NOW IN SUCCESSFUL USE.
"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

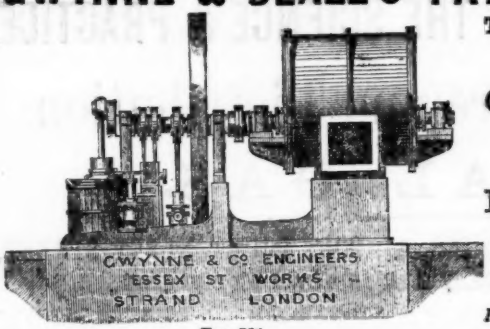


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.
HAVE MADE THE
LARGEST AND MOST PERFECT
EXHAUSTING MACHINERY
Ever produced, and the most economical in working.

Prices and every information on application.

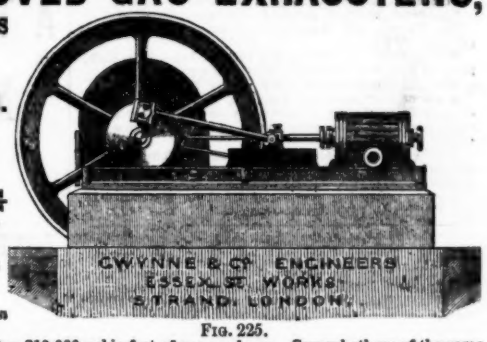
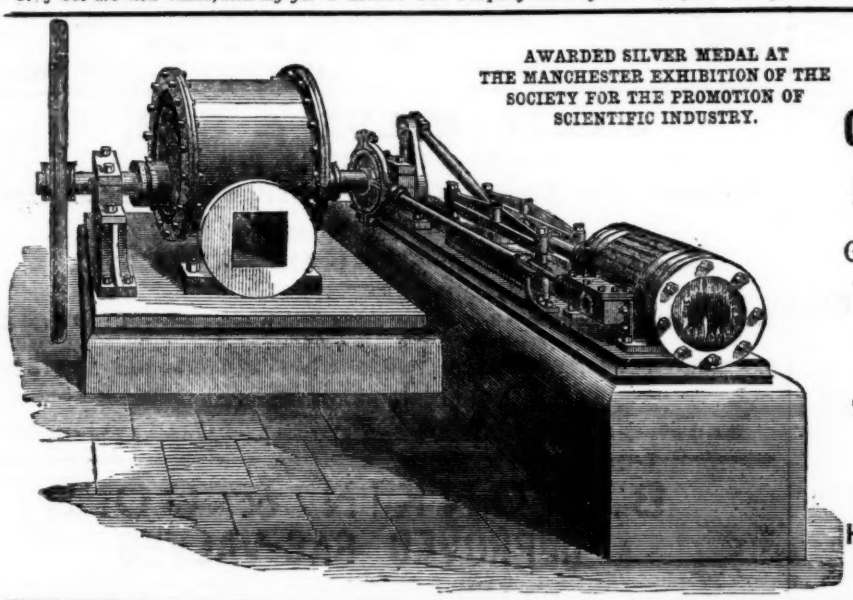


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the most perfect system of action yet discovered. Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND Co. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the excellence of the article produced, and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
CAN BE HAD ON APPLICATION TO
GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.
G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.



AWARDED SILVER MEDAL AT THE MANCHESTER EXHIBITION OF THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY.

BEALE'S
Improved Patent
GAS-EXHAUSTERS
WITH
ENGINES COMBINED.
Sole Makers,
GEORGE WALLER & CO.

Makers of
ENGINES, EXHAUSTERS,
INDEX and DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, and other PUMPS,
SCRUBBERS and PURIFIERS,
CONDENSERS, BOILERS, &c.

PHŒNIX ENGINEERING WORKS,
HOLLAND STREET, S.E.,
AND
STROUD, GLOUCESTERSHIRE.

Will shortly be ready, price 18s., bound in cloth, lettered,

THE TWENTY-EIGHTH VOLUME
(JULY TO DECEMBER, 1876)
OF THE
JOURNAL OF GAS LIGHTING, WATER SUPPLY, AND SANITARY IMPROVEMENT.

CLOTH CASES, GILT LETTERED,
For binding Vol. XXVIII., may now be obtained, Price 2s. 6d.

TERMS OF SUBSCRIPTION.

The JOURNAL OF GAS LIGHTING is supplied direct from the Office to residents in any part of the United Kingdom, at the rate of 21s. per annum, payable in advance. If credit be taken, the charge is 25s.

Halfpenny stamps may be forwarded for amounts under 5s. Any larger sum should be remitted by Money Order, payable at the General Post Office, to William B. King.

CHARGES FOR ADVERTISEMENTS.

Six lines (about 40 words) or under . . . £0 3 0
Each additional line (about 8 words) . . 0 0 6
Special Terms for Continuous Advertisers.

The insertion of Advertisements in the current week's issue cannot be guaranteed unless received at the Office by THREE o'clock p.m. on MONDAY.

The Publisher cannot be responsible for Testimonials, accompanying replies to Advertisements, left at the Office, and strongly recommends that *copies only* should be sent.

LONDON:
WILLIAM B. KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, a Working Manager, in a small Gas-Work in North Wales, who understands carbonizing and purifying gas, main and service laying, and general repairs. House, gas, and coal found.

Applications, stating salary and references, to be sent to Mr. J. T. HALL, C.E., Prescot, LANCASHIRE.

WANTED, a steady Man as Yardman and SMITH, and to live on the Works.

For particulars, apply, in own handwriting, to COTTON AND MARDON, Gas-Works, UXBRIDGE.

WANTED, Spent Oxide. The Sheffield Chemical Company, Attercliffe, are prepared to PURCHASE large or small quantities.

Address, with particulars, the Proprietors, HORNBY, FAIRBURN, AND Co.

APPOINTMENT WANTED.

THE Son of a Gas Engineer desires an APPOINTMENT as an ASSISTANT to a Manager or Engineer of Gas-Works. Is 20 years of age. Five years experience in keeping carbonizing accounts, using photometer daily, and testing for sulphur compounds, &c. Is a fair draughtsman. Moderate salary.

Address No. 337, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—A second-hand Gasholder, in good condition, 33 ft. diameter and 9 ft. deep. Has been in use about nine years. Also some 5-in. and 4-in. Donkin Valves. To be sold at a moderate price.

Apply to Mr. W. T. HEWS, Gas-Works, HENLEY-ON-THAMES.

FOR SALE—A 10 ft. Gasholder (second- hand), with metal tank, columns, pulleys, and weights, now erected and in working order. Suitable for a small factory or private residence.

Apply at LINTZFORD MILL, Lintz Green, near NEWCASTLE-UPON-TYNE.

GOVERNORS FOR SALE.

FOR SALE, at the Eccles Street Works of the Liverpool United Gaslight Company, two GOVERNORS, each having a 10-in. cone and 16-in. bye-pass.

Also four GOVERNORS, each having a 6-in. cone and 8-in. bye-pass. These Governors are in excellent order, and are fitted complete and ready for work, and have been replaced by apparatus of larger dimensions.

Apply to Mr. KING, Engineer, Gas Office, Duke Street, LIVERPOOL.

BOILERS.

FOR SALE, Cheap, Two 5-h.p. Cornish BOILERS, in good condition. May be seen at the Reading Gas-Works.

Particulars can be obtained of Mr. E. BAKER, Engineer.

FOR SALE, within 20 yards of a siding at the Harrow Railway Station, the complete IRON-WORK for a small Gas-Work, consisting of eight 15-in. round Mouthpieces, with 5-in. to 4-in. rising Pipes, 5-in. H-Pipes, Hydraulic Main, 5-in. Condenser, small Scrubber, and three 5-feet square Purifiers, with centre-valve and all connexions.

Apply to JAS. L. CHAPMAN, Engineer, Gas-Works, HARROW.

TO BE SOLD.

THE Keighley Local Board of Health have FOR SALE, by private contract, the GAS-WORKS PLANT and APPARATUS at present in use at the Low Bridge Works, in Keighley, comprising 165 Mouthpieces, Hydraulics, two 12-in. Vertical Condensers, Engine and Exhauster, Tar and Liquor Pumps, with shafting, &c., wrought-iron Scrubber, Station-Meter (Braddock's), and other apparatus, with the valves and connexions complete (12-in. diameter throughout).

The whole are in good condition, and can be seen at work, on application to the undersigned, at the Offices, Low Bridge Works, Keighley, from whom any further particulars can be obtained.

By order,
JOHN LAYCOCK.

Keighley, Dec. 21, 1876.

TO BUILDERS AND CONTRACTORS.

THE Town Council of Paisley invite TENDERS for the EXCAVATION and CONSTRUCTION of a GASHOLDER-TANK, 131 feet 8 inches diameter, and 25 feet 4 inches deep.

Plans and Specifications may be seen, and further particulars obtained, on application to the Subscriber.

Tenders, sealed and endorsed "Gasholder-Tank," to be delivered at the Town Clerk's Office, Paisley, on or before Saturday, the 27th current.

The Committee do not bind themselves to accept the lowest or any tender.

GEO. R. HISLOP, Engineer.
Paisley Corporation Gas-Works, Jan. 11, 1877.

THE Swansea Gaslight Company have for immediate SALE, the following Plant:—
A 6-h.p. Patent Trunk Engine. (Beale.)
Exhauster to pass 15,000 feet per hour. (Beale.)
An 8-h.p. Grasshopper Engine. (Easton and Amos.)
Exhauster, 20,000 ft. per hour. (Beale.)
Tar, Liquor, and Water Pumps, Eccentrics, Shafting, and Driving Pulleys.
Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.
Wrought-iron Scrubber, 5 ft. diameter, 20 ft. high.
A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.
May be seen at the Gas-Works, Swansea. The whole in perfect working order; replaced by plant of larger dimensions.
Further particulars may be obtained on application to Mr. THORNTON ANDREWS, SWANSEA.

TO GASHOLDER MAKERS.

THE Town Council of Paisley invite TENDERS for making, delivering, and erecting, a TELESCOPE GASHOLDER, outer lift 130 feet diameter by 25 feet deep, with columns and girders complete; together with a 24-in. Station-Governor, Valves, and Connexions.
Plans and specifications of all which may be seen, and further particulars obtained, on application to the Subscriber.
Tenders, endorsed "Telescope Gasholder and Governor," to be delivered at the Town Clerk's Office, Paisley, on or before Saturday, the 27th current.
The Committee do not bind themselves to accept the lowest or any tender.
GEO. R. HISLOP, Engineer.
Paisley Corporation Gas-Works, Jan. 11, 1877.

TO EXCAVATORS, BUILDERS, AND GASHOLDER MAKERS.

THE Directors of the Castleford and Whitwood Gaslight and Coke Company, Limited, invite TENDERS for the construction of a GASHOLDER TANK, 102 feet 6 inches diameter and 22 feet 6 inches deep; also for supplying and erecting One Single-Lift GASHOLDER, 100 feet diameter and 22 feet deep.
Plans and specifications may be seen at the Office of the Company, Gas-Works, Wheldale Road, CASTLEFORD, from Friday, the 5th, to Friday, the 26th inst.; and any further information may be obtained on application to Mr. T. B. WILSON, Gas Engineer, Eastfield House, CASTLEFORD.
Sealed tenders, endorsed "Tender for Gasholder," or "Tank," addressed RICHARD HEPTINSTALL, Esq., Chairman of the Castleford and Whitwood Gaslight and Coke Company, Limited, Castleford, YORKSHIRE, to be sent in not later than Friday, the 26th inst.
The Directors do not bind themselves to accept the lowest or any tender, nor will any allowance be made for such tenders.
Gas-Works, Castleford, Jan. 1, 1877.

ADVANTAGES OF GAS FOR
COOKING AND HEATING.
HINTS ON GAS BURNERS, &c.
By MAGNUS OHREN, A.I.C.E., F.C.S.
Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

T. NEWBIGGING,
CONSULTING GAS ENGINEER,
5, NORFOLK STREET, MANCHESTER.

HENRY LYON,
ENGINEER,
AND
CONSULTING GAS ENGINEER,
BROOKLYN, CHEETHAM HILL ROAD,
MANCHESTER.

ALFRED LASS,
SPECIAL ACCOUNTANT FOR GAS COMPANIES,
30, GRACECHURCH STREET, LONDON.
Accounts analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.
The Forms of Account, which have been specially designed by A. L. to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.
The above forms are registered.
Water Companies Accounts also prepared and adjusted.
CONSULTATIONS.

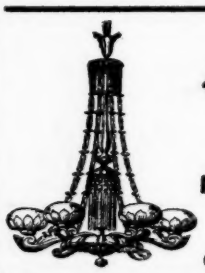
TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.
Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.
Patents procured for Foreign Countries.
Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

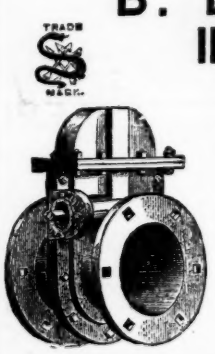
SULPHATE OF AMMONIA.

WHY sell your Liquor when it pays you better to work it up yourselves?
Consult J. JUDGE, who has put up several sets for Gas Companies with success. J. J. will undertake to work this department, and is willing to make himself generally useful as Plumber and Gas-Fitter, &c., &c.
96, NEW ROAD, WANDSWORTH ROAD, S.W.

Now ready, price One Shilling, Nos. 1 & 2 (to be continued Monthly) of
A TREATISE ON THE SCIENCE & PRACTICE
OF THE
Manufacture and Distribution
OF
COAL GAS.
LONDON: WILLIAM B. KING, 11, BOLT COURT, FLEET STREET,
OR OF ANY BOOKSELLER IN TOWN OR COUNTRY.
For the convenience of persons resident in remote districts, arrangements have been made by the Publisher to forward the "Treatise" by Post, securely packed on a wooden roller, at the cost of the number and postage only—viz., 1s. 2d. Monthly, or 7s. for the Half Year.


F. & C. OSLER,
45, OXFORD STREET, LONDON, W.
MANUFACTORY AND SHOW-ROOMS:
BROAD STREET, BIRMINGHAM.
ESTABLISHED 1807.
MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS,
WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.
TABLE GLASS OF ALL KINDS.
CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

JAMES MILNE & SON,
GAS ENGINEERS,
Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
EDINBURGH, AND
2, KING EDWARD STREET,
NEWGATE STREET, LONDON.
Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.
STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,
And every description of Gas-Fittings and Gas Apparatus.

B. DONKIN & CO.'S
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS,

List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.
These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.
VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO, SCREW WATER-VALVES WITH GUN-METAL FACES.
ALSO SOLE MAKERS OF
J. BEALE'S NEW PATENT GAS EXHAUSTERS.
B. DONKIN & CO.,
GENERAL ENGINEERS AND IRONFOUNDERS.
MAKERS OF STEAM-ENGINES,
55a, BLUE ANCHOR ROAD, BERMONDSEY,
LONDON, S.E.

GEORGE ANDERSON,
GAS AND CONSULTING ENGINEER,
35A, GREAT GEORGE STREET,
WESTMINSTER, S.W.
PATENTEE and MANUFACTURER of the following Inventions:—
RETORT SETTINGS—giving great Economy of Fuel.
STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES.
FUEL-MACHINE, for Compressing Breeze and Tar.
WASHERS, SCRUBBERS, and PURIFIERS, that Economize Space and Cost.
N.B.—Pamphlet, with Eighteen Illustrations of the foregoing, with letterpress on the construction of Gas-Works, post free, 2s. 6d.

JAMES SNOWBALL & SONS,

STOURBRIDGE FIRE-CLAY WORKS, GATESHEAD-ON-TYNE,

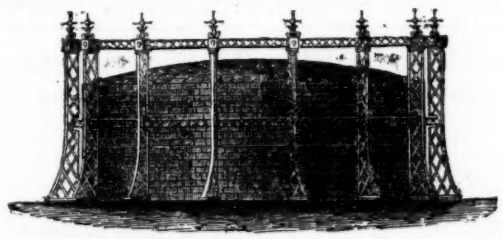
MANUFACTURERS OF

FIRE-BRICKS, FIRE-CLAY LUMPS, QUARLS, GAS-RETORTS,

SANITARY PIPES, CHEMICAL PIPES, &c.

All made of the best quality of Fire-Clay, wrought from Whickham Colliery.

J. S. & Sons having during the past year erected large Works at Derwenthaugh, in addition to their old Works at Gateshead-on-Tyne, are in a position to supply large orders with the greatest despatch.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

6, WESTMINSTER CHAMBERS, VICTORIA STREET,

GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED, LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

S. OWENS & CO.,

WHITEFRIARS STREET, LONDON, E.C.,

HYDRAULIC ENGINEERS,

AND MANUFACTURERS OF

PUMPING MACHINERY of every Description.

SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF

BLAKE'S PATENT STEAM-PUMPS,

More than 10,000 in use,

ESPECIALLY ADAPTED FOR USE IN GAS AND CHEMICAL WORKS, FOR PUMPING TAR, WATER, AMMONIACAL LIQUOR, ACIDS, &c.

The following are some of the prominent advantages of the BLAKE PUMP:—

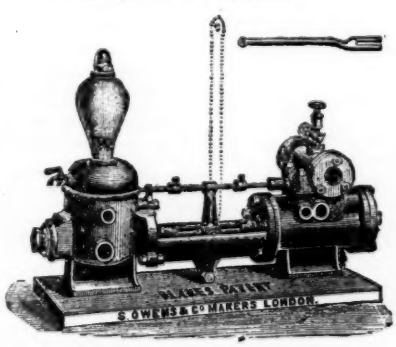
It will start at any point of stroke.

It has no dead point.

It works fast or slow, with the same certainty of action.

It is economical. Has a lead on the slide-valve.

It is compact and durable.



It is interchangeable in all its working parts.

It will deliver more water than any other pump.

It is made of best materials in the most workmanlike manner.

Can be worked at 20 strokes per hour, or 200 strokes per minute.

This Illustration represents Boiler-Feed Pumps, Sizes Nos. 1, 2, and 3, with Hand Lever for working Pump when Steam is not available.

SOLE MANUFACTURERS OF

MANN & OWENS

IMPROVED PATENT GAS-VALVES.

PRICED LISTS AND FULL PARTICULARS FURNISHED ON APPLICATION.

TO GAS & WATER COMPANIES, & MUNICIPAL AUTHORITIES SUPPLYING WATER OR GAS.

CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875.

It is required, under a PENALTY OF FIVE POUNDS, that a PRINTED COPY of the 4th SECTION of the above Act shall be posted up at all Gas and Water Works in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of the section, in large type, on broad sheets, may be had of WILLIAM B. KING, 11, Bolt Court, Fleet Street, LONDON. Price, per post, 2s. per dozen, or 10s. 6d. per 100.

The Act extends to Scotland and Ireland.

GAS-WORKS CLAUSES AMENDMENT ACT, 1871.

ANNUAL ACCOUNTS OF GAS COMPANIES.

FORMS OF ANNUAL ACCOUNTS, arranged as required by the 35th Section of the Act (34 & 35 Vict., cap. 41), are now ready.

These Forms have been printed on large sheets of paper of the best quality, and are carefully ruled so as to afford the utmost facility for compliance with the provisions of the Act.

Price 3s. 6d. per dozen, free by post, or may be ordered of any Bookseller.

LONDON: W. B. KING,
11, BOLT COURT, FLEET STREET, E.C.

A Specimen Sheet on receipt of Six postage stamps.

NOW READY,

THE

GAS COMPANIES EXPENDITURE JOURNAL,

Being a Ruled Account-Book with Printed Headings, and Analyzing Guide for Keeping, upon the easiest and most correct method, the Expenditure of a Gas Company, in accordance with the provisions of the Gas-Works Clauses Act of 1871, and suitable for all Companies.

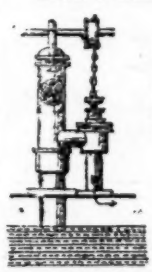
Prices, half bound, cloth sides, 2 quires, 30s.; 3 quires, 36s.; other sizes and bindings to order.

Published by EDWARD SANDELL, Accountant, 4, Skinner's Place, Size Lane, QUEEN VICTORIA STREET, and W. B. KING, Office of the JOURNAL OF GAS LIGHTING, 11, Bolt Court, FLEET STREET, E.C.

THE Vale of Neath Dinas Fire-Brick and Cement Company, Limited, Pontwalby Works, Glyn Neath, South Wales. Manufacturers of the Celebrated Genuine Dinas Fire-Bricks and Cement for Siemens's Regenerative Gas Furnaces, Bessemer Converters, Copper Smelting, Roofs of Puddling Furnaces, Glass-Works, Gas-Works, Coke Ovens, and processes involving intense and long-continued heat. Prices and estimates on application.

London Agency, 11, Queen Victoria Street, City.

COPP'S PATENT ANTI-DIP GAS APPARATUS.



Produces from 10 to 20 per cent. more gas of higher illuminating power.

Prevents the deposit of carbon.

Retorts last much longer.

Charges work off quicker.

This simple invention has been in use in many works for the last six months, with the above results.

PRICE 2 GUINEAS EACH.

Testimonials and particulars on application.

Address **WALTER L. COPP,** WATCHET, SOMERSET.

HARPER & MOORES,

PROPRIETORS OF THE

BEST STOURBRIDGE CLAYS,

STOURBRIDGE.

Manufacturers of all Descriptions of

BEST STOURBRIDGE FIRE-BRICKS, LUMPS, AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

Of every kind.

The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture.

TO GAS COMPANIES.

GEORGE McKAIG,

MANUFACTURER OF

GAS-PURIFYING WOOD SIEVES,

153, CLEVELAND STREET,

DONCASTER.

It requires but one trial to prove the Superior Make, Strength, and Durability of these Sieves.

CARRIAGE PAID.

BIRTLEY IRON WORKS,
CHESTER-LE-STREET,
DURHAM.
Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.
Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.
Agent in London, Mr. J. MANWARING, 101 Cannon Street, E.C.

BAILEY'S Patented Inventions are now in extensive use wherever steam is known. Bailey's Patent Steam Gauges, Pyrometers, Water Gauge Cocks, Test Pumps, Fusible Plugs, Steam and Water Valves, Safety Valves, Junction Valves, Pumps, Tell-Tales, Recorders, Lightning Conductors, Electric Telegraphs, Turret Clocks, Steam Joint Cement, Lifting Jacks, Boiler Feeders, Lime Catcher and Separator, Injectors and Ejectors, and every description of first-class Brass Work for Engines and Boilers. Gas-Works Managers who have not our large book should send for it.

16th edition, 1000 engravings, 4to., post free 3s. 6d. in stamps, weight 10 oz., cost of production £1000,
BAILEY'S Illustrated Inventions, containing details and prices of goods in our five several departments:—(1) Brass Foundry, Steam Gauges, Indicators, Feeders, and Fittings; (2) Engineers Sundries, Small Tools, and Stores; (3) Machine Pump and Fire Engine; (4) Turret Clock, &c.; (5) Electric Telegraph, A B C Instruments, Bells, and Apparatus.
W. H. BAILEY and Co., Albion Works, Salford, LANCASHIRE.

W. HAILES,
BUILDER & RETORT-SETTER,
CONTRACTS FOR THE SETTING OF RETORTS
In Large or Small Works, at Home and Abroad.
Sixteen Years with the Commercial Company, London. Setter for the Isle of Thanet, Dartford, and Brentford Companies, &c., &c. References if required.
ADDRESS,
3, HIGH STREET, BRENTFORD, MIDDLESEX.

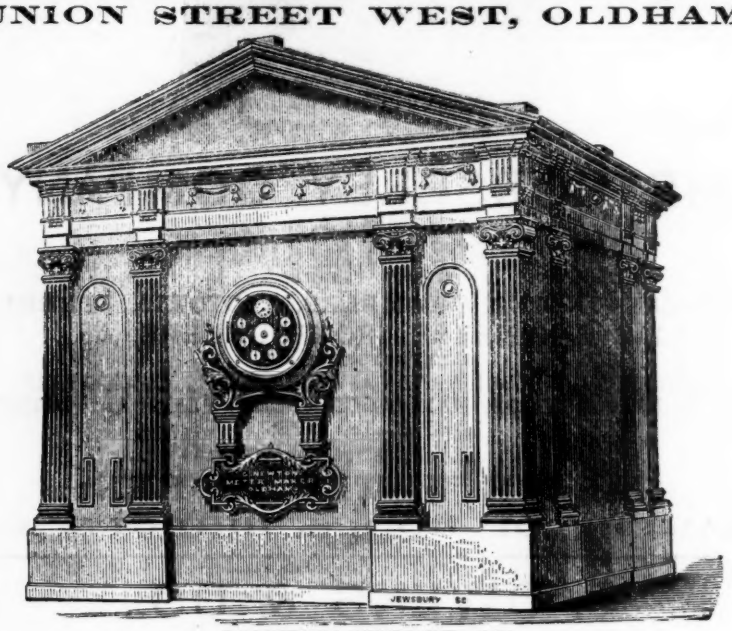
THE
SILICA FIRE-BRICK CO.,
OUGHTIBRIDGE,
Near SHEFFIELD,
Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces, and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

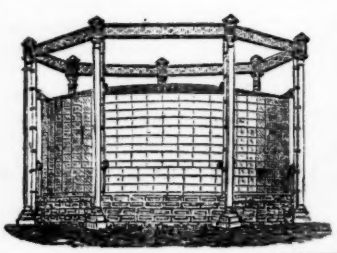
SZERELMEY STONE LIQUID,
Which waterproofs and casehardens every kind of masonry, and
SZERELMEY IRON PAINT,
"The only permanent preservative against rust," having enjoyed the approval of the most eminent authorities, including SIR CHARLES BARRY, SIR R. I. MURCHISON, PROFESSOR FARADAY, "THE TIMES," "PALL MALL GAZETTE," "ENGINEER," "BUILDING NEWS," "IRON," &c.
MESSRS. SZERELMEY & CO.
Need only offer to send prices and particulars, and to advise correspondents how to treat special cases. Address
6, MARTIN'S LANE, CITY,
LONDON, E.C.

JOHN ROMANS, C.E., F.G.S.E.,
CONSULTING GAS ENGINEER
AND
CANNEL COAL FACTOR,
30, St. Andrew Square, EDINBURGH.
Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.
GAS-WORKS TAKEN ON LEASE.
Mr. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.
ANALYSIS AND PRICES FORWARDED ON APPLICATION.

REDHEUGH COLLIERY,
NEWCASTLE-ON-TYNE,
The Owners of the above Colliery are now prepared to ship their
FIRST-CLASS GAS COALS,
F.O.B. TYNE DOCKS.
By analysis, these Coals give 10,000 cubic feet of gas per ton, with an illuminating power equal to 14·5 sperm candles, and a large per centage of first-class Coke.
Buyers can rely upon the Coals being fresh wrought, and free from pyrites, band, &c.
For prices, &c., apply to
ROBT. HINDHAUGH,
FITTING OFFICES, NEWCASTLE-ON-TYNE.

GEORGE ORME & CO.,
ATLAS METER-WORKS, OLDHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS.
STATION-METERS, GOVERNORS,
PRESSURE AND EXHAUST REGISTERS,
LAMP-METERS IN CAST-IRON BOXES,
And every Description of Gas Apparatus.

GEORGE NEWTON,
UNION STREET WEST, OLDHAM,

MANUFACTURER OF
SQUARE STATION-METERS, with PLANED JOINTS;
ROUND STATION-METERS, WITH CAST-IRON STANDS;
WET AND DRY CONSUMERS GAS-METERS, GOVERNORS, &c.

SAM. CUTLER & SONS,
CONTRACTING GAS ENGINEERS,
GASHOLDER & GENERAL GAS APPARATUS MAKERS,
MANUFACTURERS OF
BOILERS, IRON ROOFING, IRON BRIDGES,
AND GENERAL IRONWORK.

S. C. AND SONS undertake Contracts of any magnitude for the **Erection of new and Remodelling of existing Gas-Works,** for **Gasholders, Cast and Wrought Iron Tanks, Iron Roofs,** and every description of **Apparatus** for the Manufacture and Distribution of Gas.
Special attention is invited to their **"Improved Condenser,"** which is very effective, and much approved; also to their patterns of **Annular** and other **Condensers, Scrubbers,** and **Purifiers,** of all sizes, which they arrange either with **Centre** or Ordinary **Slide Valves.**
WORKS FOR THE SUPPLY OF
VILLAGES, MANSIONS. FACTORIES, &c.
S. C. AND SONS undertake the **Supply** and **Laying** of **Mains** for **Gas and Water,** and supply all **Castings,** Connexions, and Fittings for Retort-House, Works generally, and for Streets. They also supply **Valves** of all descriptions, Iron and Clay Retorts, Hotpressed Retort-Lids, Steel Charging-Scoops of improved make, for which they have special machinery, Improved Coke and Coal Barrows, Cross-Bars and Screws, Bolts and Nuts, Furnace and Stoking Tools, Iron and Wood Purifier-Sieves, Lead, Yarn, Borings, &c., including every requisite whatsoever for a Gas-Work, a well-assorted stock being kept of those goods most in request.
SOLE MAKERS OF BRETT'S PATENT COKE BARROW.
Experienced Retort Setters sent to any part of the Kingdom.
Address: PROVIDENCE IRON-WORKS, MILLWALL, LONDON.

JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

CATHELS'S Patent District Dry Gas-GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, ROTHERHAM.

CATHELS & TERRACE'S Patent Four-WAY DISC GAS-VALVE is the simplest and best Valve for Purifiers, and as a By-pass for other apparatus in Gas-Works. It is always gas-tight, and has no springs, ground faces, or other delicate parts. By its use the flow of the gas cannot be accidentally stopped, and it never sticks.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, Foundry and Brass Works, ROTHERHAM.

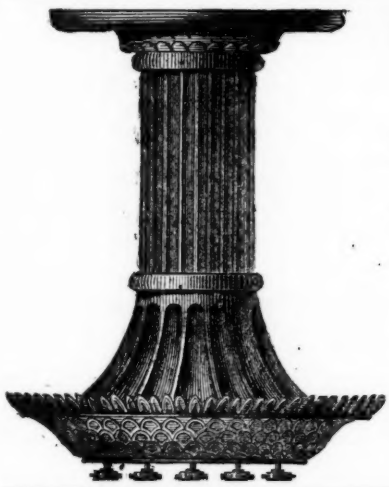
THE WIGAN COAL & IRON COMPANY,

LIMITED,

DISTRICT OFFICE: 18, BENNETT'S HILL, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.



HENRY GREENE & SON,

GAS AND HOT WATER ENGINEERS,

155, CANNON STREET, E.C.

Manufactory: 19 & 20, NICHOLAS LANE, E.C.

SUN-BURNERS,

With Regulating Valves to obviate down draught.

MEDIÆVAL & OTHER GAS-FITTINGS

For Churches and Domestic Use.

ARCHITECTS' OWN DESIGNS WORKED OUT.

ESTIMATES FREE OF CHARGE.

THE TRADE SUPPLIED.

SOLE CONSIGNEES FOR BRÖNNER'S IMPROVEMENTS IN GAS LIGHTING.

IN THE MATTER OF

BRÖNNER'S

GAS-BURNERS.

HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

JOHN ABBOT AND CO.,

LIMITED,

IRON AND BRASS FOUNDERS,

PARK WORKS, GATESHEAD-ON-TYNE.

London Office: 2, SUFFOLK LANE, CANNON STREET.

Glasgow Office: 54, ST. ENOCH'S SQUARE.

MANUFACTURERS OF ALL DESCRIPTIONS OF

HYDRAULIC MACHINERY,

INCLUDING

ACCUMULATORS, FORCE-PUMPS, CRANES, & LIFTS,

FOR

GAS-WORKS, WAREHOUSES, &c.

IMPROVED HYDRAULIC MACHINERY,

Specially Arranged for Lifting and Lowering Purifier-Covers, &c.

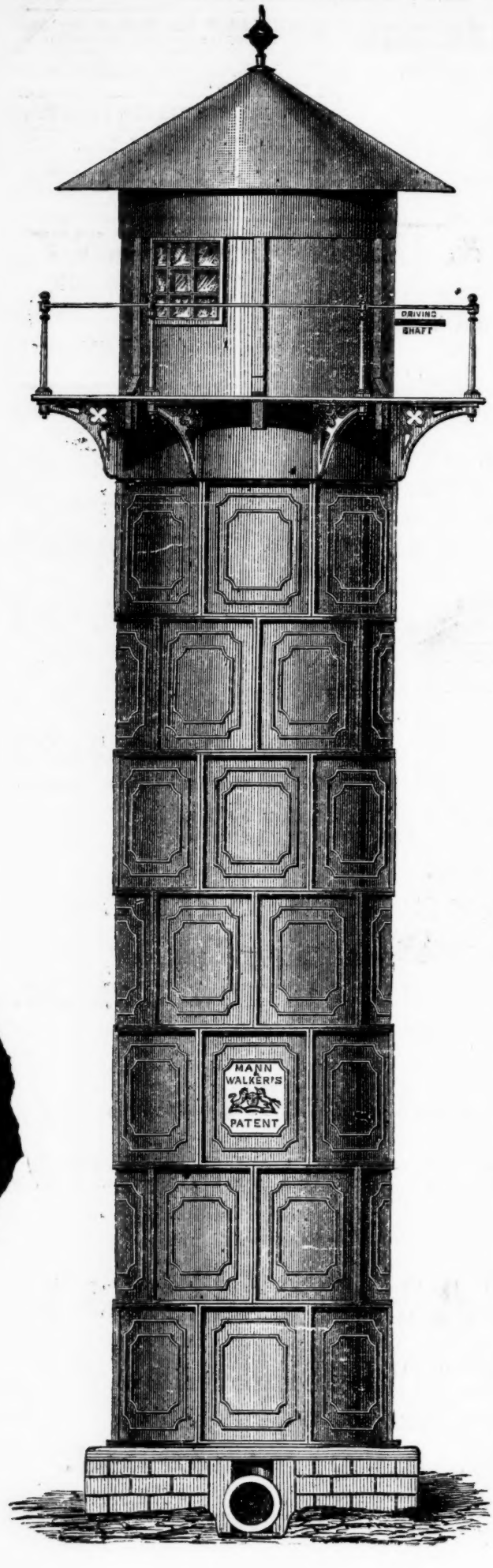
MAKERS OF

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS;

PIPES FOR GAS AND WATER WORKS;

ROOFS, COLUMNS, AND GIRDERS.

DESIGNS AND ESTIMATES SUPPLIED ON APPLICATION.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

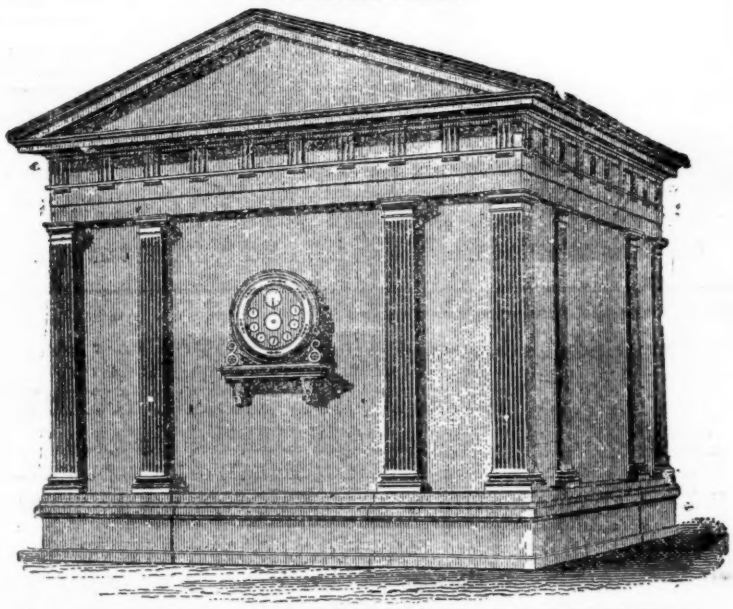
Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

J. EDMUNDSON & CO.,
19, GREAT GEORGE STREET, WESTMINSTER,
LONDON, S.W.,
MANUFACTURERS OF EVERY DESCRIPTION OF
GAS APPARATUS.
CONTRACTORS FOR THE
ERECTION OF GAS-WORKS, GAS-FITTINGS, &c.,
FOR TOWNS, COUNTRY MANSIONS, &c.
Estimates given free of Charge.

J. & J. BRADDOCK,
GAS ENGINEERS,
GLOBE METER-WORKS, OLDHAM,
MANUFACTURERS OF
WET & DRY CONSUMERS GAS-METERS,
OF THE HIGHEST EXCELLENCE ONLY;
ALSO LICENSEES AND MANUFACTURERS OF
WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;
ROUND STATION-METERS,
ON CAST-IRON STANDS.



SQUARE STATION-METERS,
WITH PLANED JOINTS.
GOVERNORS, GAUGES, INDICATORS, MAIN COCKS, &c.
GAS COOKING APPARATUS.
Home and Foreign Orders promptly attended to.
All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.
Orders almost invariably despatched on the day of receipt.
TERMS, &c., ON APPLICATION.

JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,
Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
CHARLES HORSLEY, Agent.

ADDISON POTTER,
WILLINGTON QUAY,
NEAR NEWCASTLE-UPON-TYNE,
Manufacturer of
CLAY RETORTS, FIRE-BRICKS, AND EVERY DESCRIPTION OF FIRE-CLAY GOODS

THOMAS CARR & SON,
MANUFACTURERS OF
FIRE-BRICKS, LUMPS, TILES, RETORTS, &c., &c.,
SCOTSWOOD FIRE-BRICK WORKS,
SCOTSWOOD-ON-TYNE.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and "HONOURABLE MENTION" for good quality of Fire-Bricks.
WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

LAMP-PILLARS,
GAS-LAMPS, FOUNTAINS.
Our New and Choice Designs for the above, with prices, are forwarded to any part of the world on receipt of twelve stamps. Estimates for work at home or abroad.
W. T. ALLEN & CO.,
GAS & WATER ENGINEERS & CONTRACTORS,
203, UPPER THAMES STREET,
LONDON, E.C.

C. & W. WALKER'S
WOOD PURIFIER SIEVES,
Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.
MIDLAND IRON-WORKS,
DONNINGTON, NEAR NEWPORT, SHROPSHIRE.
8, FINSBURY CIRCUS, LONDON.

CATOPTRIC
LAMPS.
The NEW PATTERN
Is now placed throughout
CHEAPSIDE.
For Terms of Licence to Use and Manufacture, apply to
Mr. SKELTON,
37, ESSEX STREET,
STRAND.

ALBERT GAS COAL.

THE DERBYSHIRE
SILKSTONE COAL COMPANY,
LIMITED,
CAN OFFER A
GAS COAL
Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	10,775
Weight of coke in lbs. per ton of coal	1,465

ANALYSIS AND PRICES ON APPLICATION TO
Mr. EDMUND TAYLOR, Secretary,
ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

TROTTER, HAINES, & CORBETT,

BRETTELL'S ESTATE

FIRE CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

E. BAKER AND CO., LATE BRIERLEY HILL, STAFFORDSHIRE.

MOBBERLEY & PERRY,

FIRE CLAY and BRICK WORKS,

STOURBRIDGE.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAY.

Manufacturers for Home and Export.

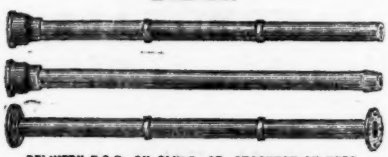
GAS-RETORTS, GLASS-HOUSE FURNACE, BLAST-FURNACE, TANK BRICKS, LUMPS, TILES, And Every Description of Best Fire-Bricks.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

18 & 20, ALSTON STREET, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



DELIVERY F.O.B. ON CLYDE, OR STOCKTON-ON-TEES.

Prices on application.

THOMAS TURTON AND SONS,

SHEAF AND SPRING WORKS,

SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY

FOR ENGINEERS,

STEEL OF ALL DESCRIPTIONS,

SCREW STOCKS, TAPS, AND DIES, SPANNERS, RATCHET BRACES, LIFTING-JACKS, ANVILS, VICES, AND ENGINEERS TOOLS GENERALLY.

LONDON WAREHOUSE:

35, QUEEN STREET, CANNON STREET, E.C.

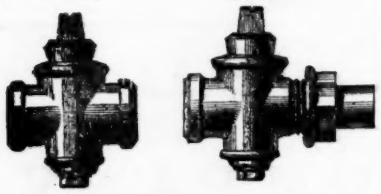
LAMBERT'S

CAST-IRON GAS-MAIN COCKS,

WITH PATENT WHITE METAL PLUGS.

TRADE (L) MARK.

No. 758. No. 759.



The bodies of these Taps are made of iron, black or galvanized, and the plugs of patent metal. They are warranted not to set fast or corrode, as do Iron or Brass Cocks; will always work easily; are strong, well made, durable; of little or no intrinsic value, and therefore not likely to be stolen; and the prices as stated below are (especially upon the larger sizes) fully 50 per cent. less than Brass Cocks.

	½	¾	1	1¼	1½	2-inch.
No. 758, with inside screws for iron pipe, black	2/0	3/0	4/4	6/6	7/6	12/0 each.
No. 759, with union on one end screwed inside for iron pipe, black	2/9	3/10	5/4	8/0	9/0	15/6 each.
Nos. 758 and 759, galvanized	0/3	0/4	0/6	0/8	0/10	1/4 extra.

MANUFACTORY:

SHORT STREET, LAMBETH, LONDON.

ALFRED WILLIAMS,

PHŒNIX FIRE-BRICK WHARF,

64, BANKSIDE, SOUTHWARK, LONDON, S.E.

GAS ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS,

AND FOR THE

SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,

AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

TO GAS COMPANIES AND THE TRADE.

J. DEFRIES & SONS,

MANUFACTURERS OF

CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS, VESTIBULE LAMPS, AND THE PATENT CRYSTAL ILLUMINATION.

A LARGE STOCK ALWAYS IN HAND OF

IRON, BRASS, COMPOSITE, AND LEAD TUBES, FOR GAS AND WATER,

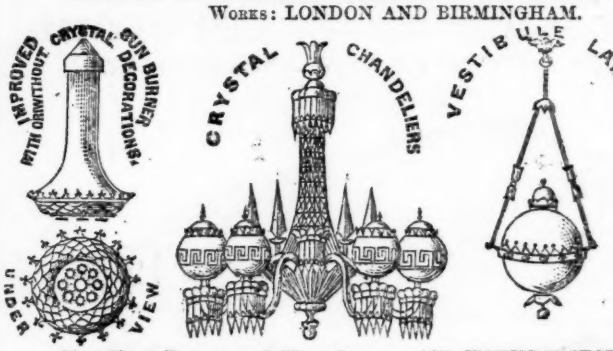
AND EVERY DESCRIPTION OF

GAS AND WATER FITTINGS.

THE PATENT DRY AND WET METER, WITH THE LATEST IMPROVEMENTS.

STREET LAMPS AND COLUMNS IN GREAT VARIETY.

WORKS: LONDON AND BIRMINGHAM.



GAS MOONS, Cut and Engraved, of the newest designs

GAS REFLECTORS In Silver and Glass

GAS NIBS AND **BURNERS** Of every description.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1876, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.

ESTABLISHED 1830.

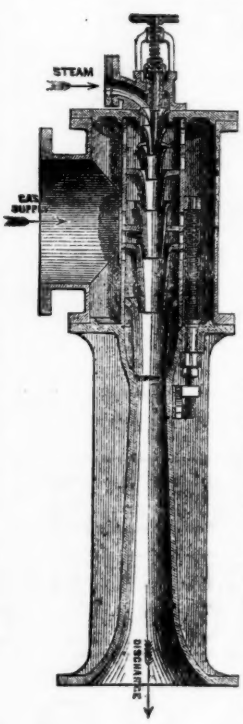
KÖRTING BROS.,

Steam-Jet Engineers,

7 and 17, LANCASTER AVENUE, MANCHESTER,

40, LOWER GARDINER STREET, DUBLIN.

Germany: Cellerstr. 35, Hannover. Austria: Kolring., Pestalozzigasse 6, Vienna. France: 11, Rue Louis-le-Grand, Paris. U. S.: 1645, N. 10th St., Philadelphia.



E. KÖRTING'S PATENT

STEAM-JET GAS-EXHAUSTER.

IMPROVED CLELAND'S PATENT.

Small Cost—Compactness—Perfectly Self-Acting—Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—No Extra Room Required—No Wear and Tear—No Noise—No Oscillation in Vacuum, or Back Pressure.

UPWARDS OF 200 IN USE.

SUPPLIED TO—

Chartered Gas Co.	Glasgow Corporation.	Hanna, Donald, and Wilson, London.
London Gas Co.	Leyland Gas Co.	Ratcliff Gas-Works.
S. Metropolitan Gas Co.	Stalybridge Gas-Works.	Kendal Gas-Works.
Phœnix Gas Co.	Lincoln Gas-Works.	Longton Gas Co.
Liverpool Gas Co.	Birmingham Gas-Works.	Dartford Gas Co.
Bolton Corporation.	Wakefield Gas-Works.	Exeter Gas Co.
Horsham Gas Co.	Brentford Gas-Works.	Harrogate Gas Co.
Epsom and Ewell Gas Co.	Burnley Gas-Works.	Hertford Gas Co.
Ipswich Gas Co.	Guildford Gas-Works.	Waterside Gas-Works, Todmorden.
Cheltenham Gas Co.	Gloucester Gas-Works.	F. W. Grafton and Co., Accrington.
Sandwich Gas Co.	Kirkintilloch Gas-Wks.	
Cornholme Dis. Gas-Wks.	Nantwich Gas-Works.	
Bury Gas-Works.	Enniskillen Gas-Works.	
	&c., &c., &c.	

E. KÖRTING'S PATENT STEAM-JET REVIVIFYING BLOWERS FOR THE PURIFYING MATERIAL.

SOLE LICENSEES FOR

W. CLELAND'S PATENT STEAM SCRUBBER,

Combining small cost and thorough efficiency, with absence of any mechanical means and necessity of renewing the scrubbing material.

FOR PARTICULARS, APPLY TO

KÖRTING BROS., 7 and 17, Lancaster Avenue, MANCHESTER,

40, Lower Gardiner Street, Dublin,

OR TO

GERALD J. TUPP, 8, John Street, Adelphi, W.C., LONDON,

SOLE AGENT FOR ENGLAND AND WALES.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
173, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL
Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL
Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL
Yields 13,320 cubic feet of 32·5-candle gas per ton.
Prices and full Analyses on application.

GAS COAL.
POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.
One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.
For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

HEBBURN MAIN GAS COALS.

Cubic feet of Gas yielded per ton . . .	10,050
Illuminating power in sperm candles . .	15·4
Yield of coke per ton of good quality . .	13¾ cwts.

THE TYNE COAL COMPANY, LIMITED, OWNERS.
W. RICHARDSON, Fitter,
29, QUAYSIDE, NEWCASTLE-ON-TYNE.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,
CANNEL COAL MERCHANT,
HAYMARKET, EDINBURGH.
Established 1840.

PLUTONIC CEMENT,
For Jointing and Repairing Retorts and Ovens both in and out of Action.
Used in the principal London and Provincial Gas-Works as a great aid to the economical production of Gas.
WILLIAM RICHARDSON,
GAS ENGINEER.
CHARLES HENRY STREET AND BISSELL STREET, BIRMINGHAM.

LESMAHAGOW CANNEL COAL.
FERRAND DAVIES,
148, GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.,
SOLE AGENT FOR
THOMAS BARR'S LESMAHAGOW MAIN CANNEL.
Quotation and Analysis forwarded on application.

B. CARPENTER,
(ESTABLISHED MORE THAN 16 YEARS,)
THE ORIGINAL MANUFACTURER OF
WOOD SIEVES
FOR
GAS PURIFIERS & SCRUBBERS.
WORKS:
22, HERMES STREET, PENTONVILLE ROAD, LONDON, N.

G. J. EVESON,
GAS COAL MERCHANT,
STOURBRIDGE.
Delivery per Rail to any Part.

"SELLARS' CEMENT"
PREVENTS WASTE OF GAS FROM RETORTS;
SAVES CLAY RETORTS FROM DESTRUCTION BY FIRE;
GREATLY ECONOMIZES THE USE OF FIRE-BRICKS;
And PREVENTS ALL POSSIBLE LOSS of GAS FROM LEAKAGE.
J. C. SELLARS,
THE GAS CEMENT WORKS,
BIRKENHEAD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,
DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—
"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."
The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.
PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

MESSRS. NEWTON, CHAMBERS, & CO.,
THORNCLIFFE IRON-WORKS AND COLLIERIES,
NEAR SHEFFIELD,
STRONGLY RECOMMEND A TRIAL OF THEIR
CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—
(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.
Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.
These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.
APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

NEW PATENT WET GAS-METER,

THE "RELIANCE,"

MANUFACTURED BY THE

GAS-METER COMPANY,

238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

The object attained by this invention is the *correct measurement of Gas under every fluctuation of the pressure.*

Accuracy is obtained by subjecting the whole of the water which determines the measuring chambers of the drum to one uniform even pressure, and so prevents unequal displacements of the water-line.

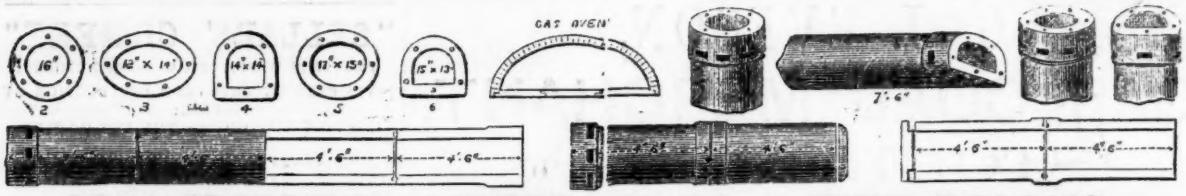
The "RELIANCE" METER has been tested by several of the most experienced official meter inspectors. Copies of their reports may be obtained on application to the

GAS-METER COMPANY,

238, KINGSLAND ROAD, LONDON.

HARRIS & PEARSON,

FIRE-CLAY AND BRICK WORKS, STOURBRIDGE.

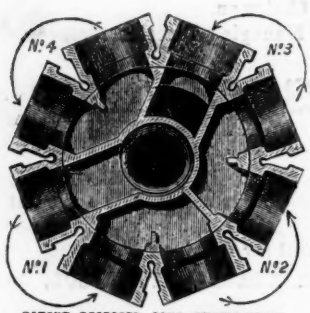


GAS-RETORTS, LUMPS, TILES, & FIRE-BRICKS,

OF EVERY DESCRIPTION.

A LARGE ASSORTMENT OF GAS-RETORTS IN STOCK.

STOCK FOR EXPORT READY AT THE WORKS, AND AT ELLESMERE PORT.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.

R. LAIDLAW AND SON,

EDINBURGH AND GLASGOW,

SOLE MAKERS OF

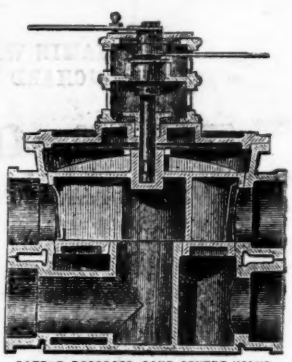
PATENT

RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

LONDON OFFICE: 106, CANNON STREET.

D. HULETT and CO., 55 and 56, HIGH HOLBORN, LONDON,

PATENTEES and MANUFACTURERS of the ONLY GOOD MERCURIAL GAS REGULATOR

Invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.

MANUFACTURERS OF

GAS CHANDELIERS, GLASS LUSTRES, HALL LANTERNS, VESTIBULES, BRACKETS, PENDANTS;

DOUBLE CONE, ALBERT, SHADOWLESS, & EVERY DESCRIPTION OF BURNER, UNION JETS, BATSWINGS, ETC.;

IMPROVED FULL-WAY CARTER'S VALVES (much approved of);

GAS-STOVES, and every article connected with Gas Apparatus.

CAST & WROUGHT IRON PIPE, BLACK & GALVANIZED. COPPER, TIN, BRASS, & COMPOSITION TUBING.

D. HULETT'S IMPROVED SERVICE CLEANSER

for clearing out Mains, Services, and Interior Fittings—70s. net.

Boyle's Patent Silvered Glass Combination Reflectors and Outside Lanterns.

Sole Manufacturers of Church and Mann's Photometer.

Large Pattern-Books, with every description of Gas-Fittings, Chandeliers, &c., with complete Book of Prices, 12s.

London: Printed by WILLIAM BOUGHTON KING (at the office of Clayton and Co., 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, January 16, 1877.